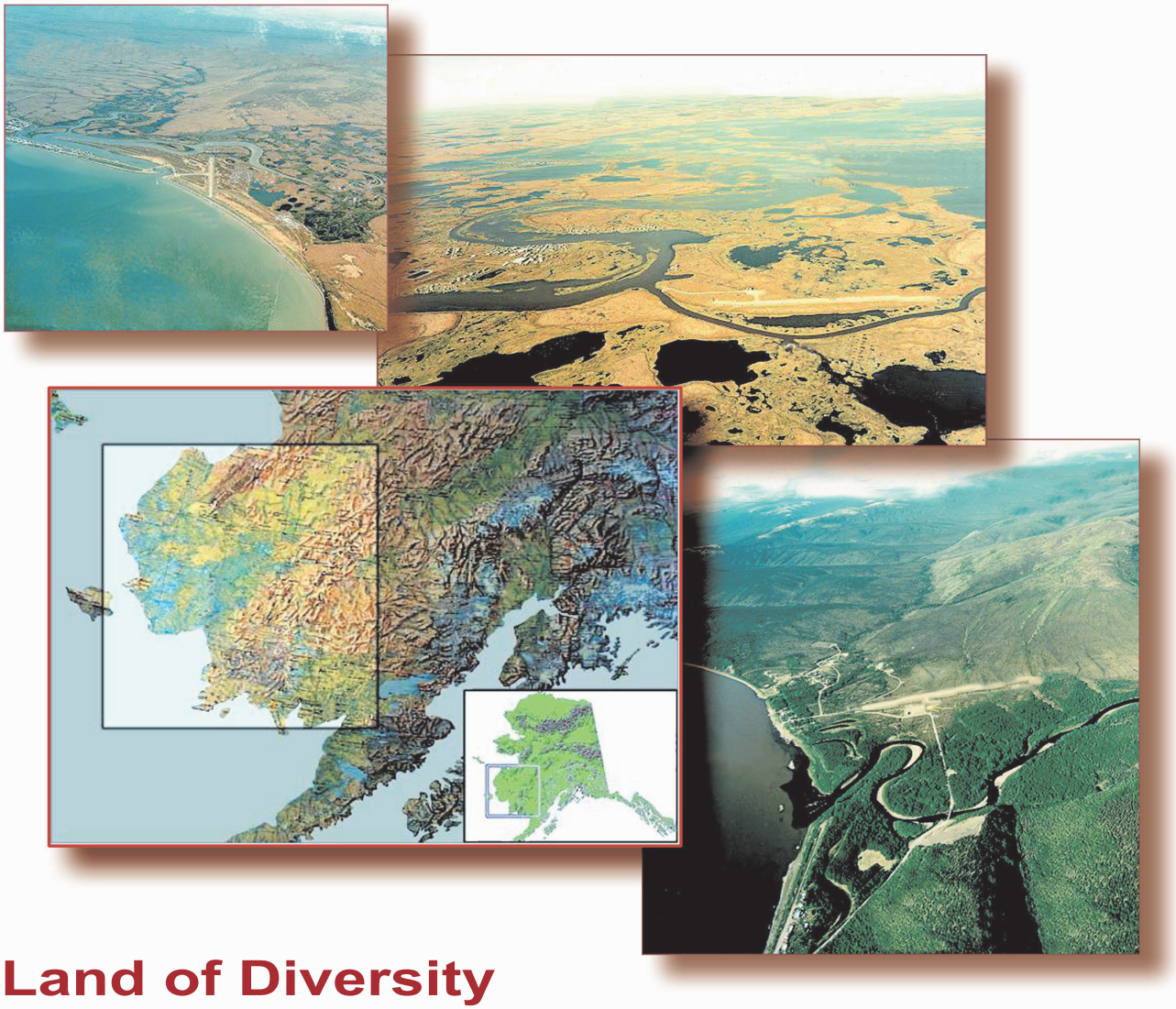
Yukon-Kuskokwim Delta

Transportation Plan

An Element of the
Alaska Statewide Transportation Plan

Alaska Department of Transportation
and Public Facilities
March 2002

Yukon-Kuskokwim Delta Region



A Land of Diversity

Alaska Department of Transportation and Public Facilities
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Clockwise from Top Left:

Coastal Village, Tununak (www.alaska.faa.gov/flytoak/data/region.idc; FAA, Alaska Region)

Tundra Village, Nunapitchuk (FAA, Alaska Region)

Upriver Village, Crooked Creek (FAA Alaska Region)

Regional Map (AK DOT&PF)

Cover:

Bethel Camai Girl (Alaska DCED, Community Database Online, www.dced.state.ak.us/mra/CF_PhotoIndex.cfm; DCED)

Contents

Tables

Figures

Courtesy Alaska Museum of History and Art

Section 1. Introduction

The Yukon–Kuskokwim Delta Transportation Plan (Y-K Delta Plan) describes the region's transportation systems, outlines the data and models used to analyze transportation trends, and defines projects needed to meet projected demand for each transportation mode. The study area is shown in Figure 1-1. The plan is one of six Area Transportation Plans being incorporated into the Statewide Transportation Plan. The Statewide Plan, which includes the Area Plans, the National Highway System Plan, Aviation System Plan, and other planning efforts, guides DOT&PF capital budget programs.

The mandate for this plan and the other five department Area Transportation Plans is to examine how DOT&PF and other transportation funding agents can assist or improve transport into and out of a rural region, and improve transport between communities.

1.1 Developing the Plan

The Y-K Delta Plan is a 20-year plan although extension beyond 2020 may be required to implement some of its elements. The 20-year period allows examination of long-term developments, but stays within accepted modeling parameters and timelines. DOT&PF typically reviews and updates a long-range plan at least every ten years.

DOT&PF worked extensively with Y-K Delta residents and governments through almost 100 meetings to develop the Y-K Delta Plan. DOT&PF held meetings with education and health care professionals throughout the region and worked with businesses, including the mining community, village grocery stores, and barge operators, to understand business transportation needs.

Many village meetings included an interpreter who translated between Yup'ik and English. The interpreter was able to facilitate in-depth discussions with the region's Elders, especially early in the planning process, which helped the planning team understand key concerns about winter trail safety, airport needs including snow removal equipment problems, and operating conditions at barge landings along the rivers and coastline.

The plan reflects continuous discussions with the aviation community and the United States Postal Service (USPS) about aviation safety, airport operational needs, and transport issues related to the fourth-class mail system (Bypass mail). Bypass mail currently delivers almost 48 million pounds of consumer goods to the region's 54 villages on almost 300,000 flights a year, roughly equal to the region's annual passenger flights per year.

The Association of Village Presidents (AVCP), the region's non-profit tribal corporation, worked with tribal and city governments to set up highly successful village meetings led by DOT&PF in the spring of 2000 to review the Y–K Delta Plan's Findings and Conclusions. AVCP staff who participated in the meetings were key to the success of the meetings. Talks with Elders and leaders throughout the region resulted in substantive improvements to the draft plan. Calista, the region's for-profit corporation, provided important information throughout the plan development.

At each step in the plan, DOT&PF met with the 14 member Advisory Committee. The committee, made up of leaders from the region, reviewed plan products and provided guidance on transportation needs and issues. The DOT&PF Maintenance and Operations Division Area Manager and individual airport maintenance contractors also provided essential understanding of airport and road operational needs.

While the Y-K Delta Plan focuses on system-wide and inter-community transportation issues, at almost every village speakers asked the planning team to convey to DOT&PF management their concerns about local street and airport dust problems. Dust creates respiratory problems and contaminates drying fish and game. Because of these comments and comments from rural communities throughout the State, DOT&PF is adding this class of local dust control projects to its Rural Priority Projects category along with roads to water, sewer, and landfill facilities. The department is now examining how to develop effective dust control projects for rural communities.

Because DOT&PF recognizes that many basic needs exist in the region, projects revealed early in the analysis stage of the planning effort have been completed or already entered into the department's State Transportation Improvement Program (STIP) and the Aviation Improvement Program (AIP). The remaining projects will be incorporated after the plan is approved.

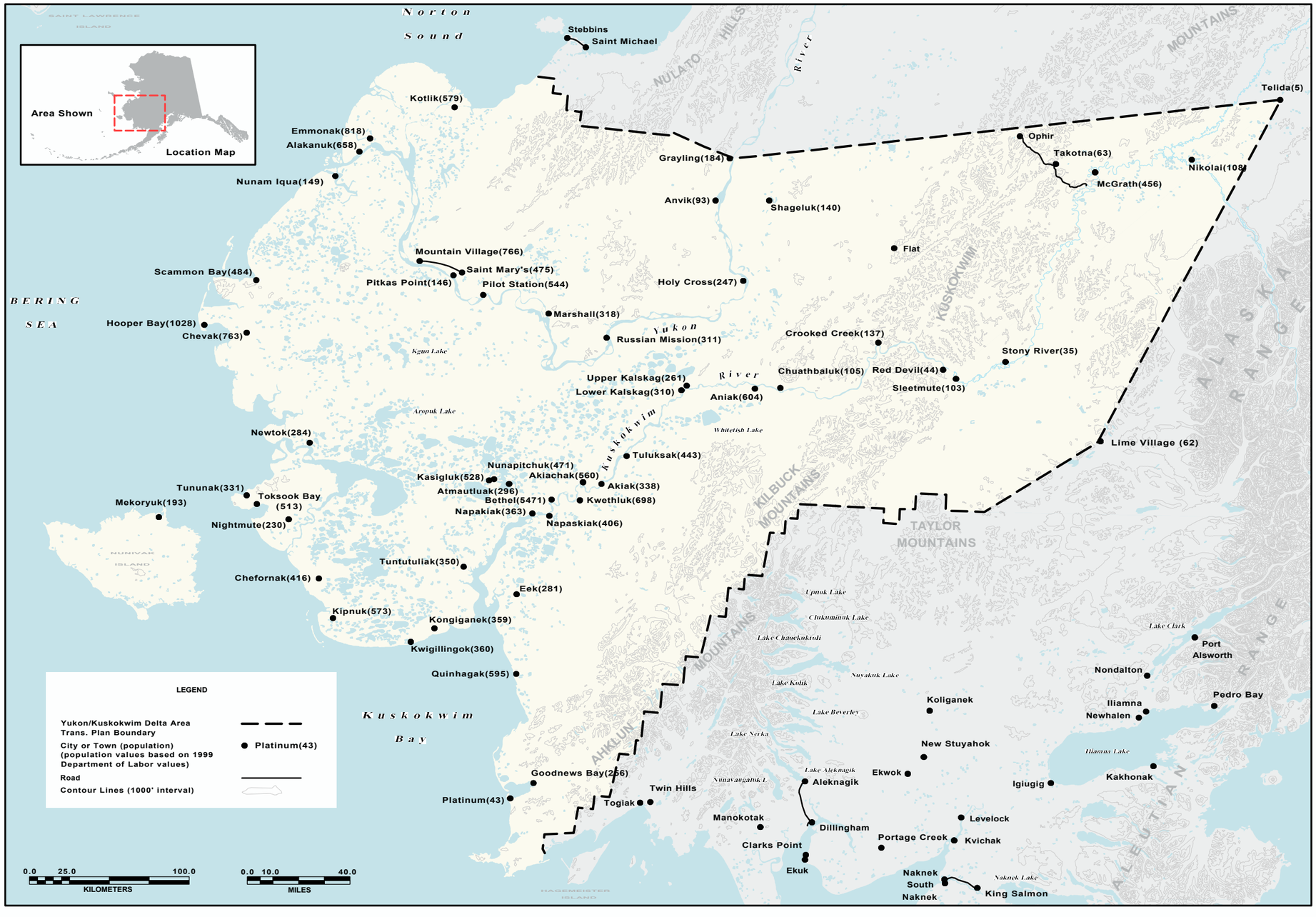


Figure 1-1 Yukon-Kuskokwim Delta Region Study Area (AK DOT&PF)

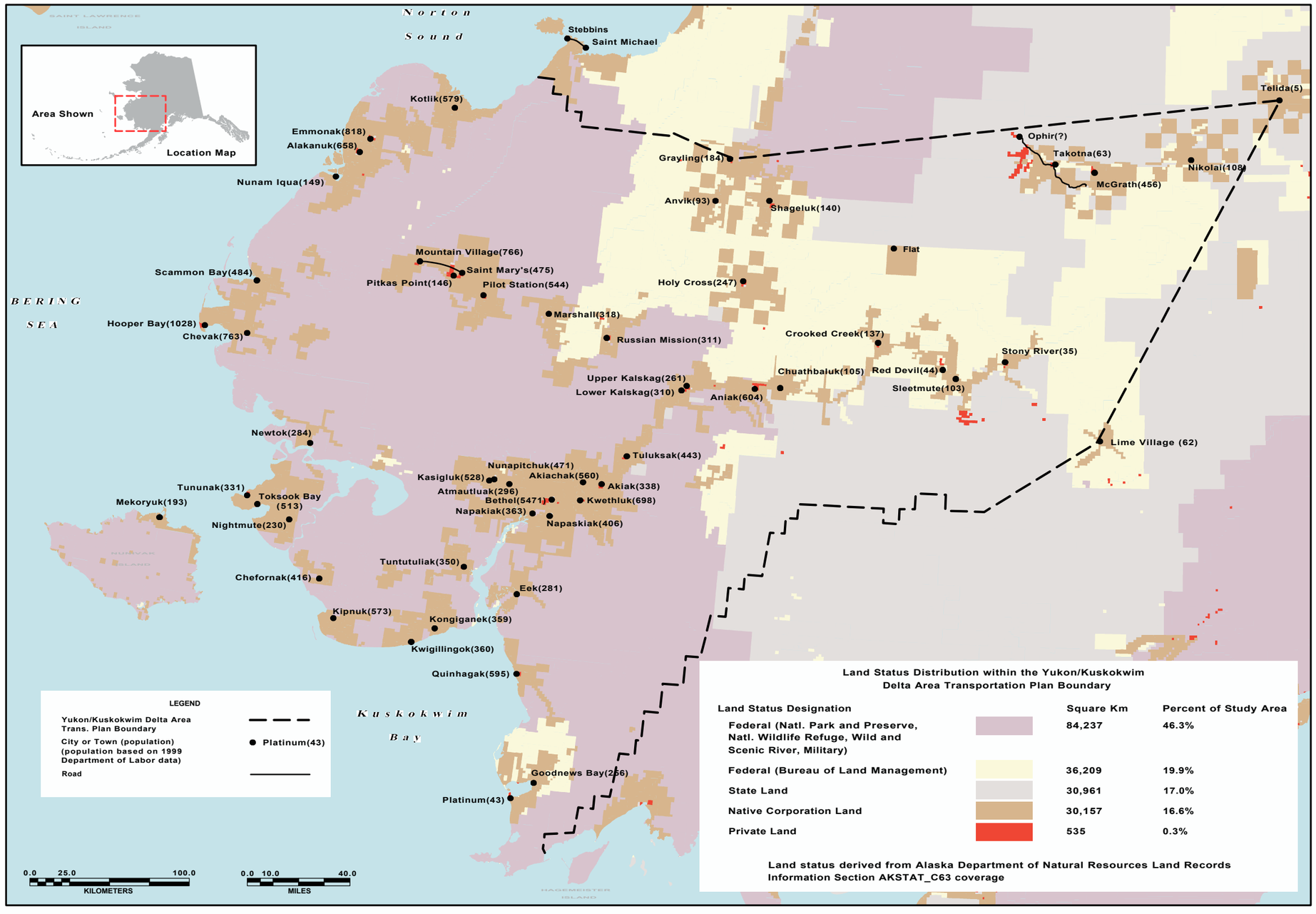


Figure 1-2 Land Status of the Y-K Delta Region (AK DOT&PF)

1.2 Y-K Delta Land and People

Books that help readers understand the region include the Alaska Geographic Society books, *Kuskokwim River* (1988) and *Lower Yukon River* (1990). *The Alaska Regional Profile, Volume III, Southwest Region*, edited by Lydia L. Selkregg, is also a good source of general data and *Bashful No Longer* (1990), by anthropologist Wendell H. Oswalt, is one of several good books delineating the ethnohistory of the people of the area. [1]

1.2.1 Land

The 182,000 square kilometer region has two very diverse areas, the Bering Sea coast and lower reaches of the Kuskokwim and Yukon Rivers, and the upper Kuskokwim River area. Much of the land, 66%, is Federal Preserve or Bureau of Land Management controlled as shown in Figure 1-2.

Coastal Lowlands

The coast and lower rivers, including Bethel, is where most of the region's 25,000 people live in 34 villages. The climate is windy, cold in the winter, and mild in the summer. Barges transport almost all fuel and heavy freight. Air carriers provide passenger service and most other freight needs. Skiffs and snowmachines are the region's primary personal transport. An ice road out of Bethel provides some local winter transport of people and fuel/freight from Eek to Aniak.

The river delta area, which has little topographic relief, is primarily shallow lakes, ponds, creeks, rivers, and sloughs over permafrost soils (Figure 1-3). The few upland areas in the flood plain (Nelson Island, Scammon Bay, and other areas along the coast) are old volcanic cones or islands.

Vegetation is generally wet tundra, although riverbanks, creeks, and sloughs that drain adjacent soils support alder, poplar, spruce, and willows. The soils are usually fine-grain sediments. The combination of the soils, wetlands, and permafrost (a condition found in most western and arctic coastal areas) often requires expensive construction techniques.

1. Other important references include Wendell H.Oswalt, *Eskimos and Explorers*, 2nd Edition, Chapter 9, "Alaskan Yuit," University of Nebraska Press; Wendell H. Oswalt, *Historic Settlements along the Kuskokwim River*, Alaska State Library Historical Monograph No. 7, 1980; Ann Fienup-Riordan, *Agayuliyararput, Kegginaqutm,Kanglit-llu (Our Way of Making Prayer - Yup`ik Masks and the Story They Tell),* Anchorage Museum of History and Art, 1996; A. Oscar Kawagley, *A Yupiaq Worldview (A Pathway to Ecology and Spirit)*, Waveland Press, 1995; James H. Barker, *Always Getting Ready or Upterrlainarluta (Yup'ik Eskimo Subsistence in Southwest Alaska),* University of Washington Press, 1993.

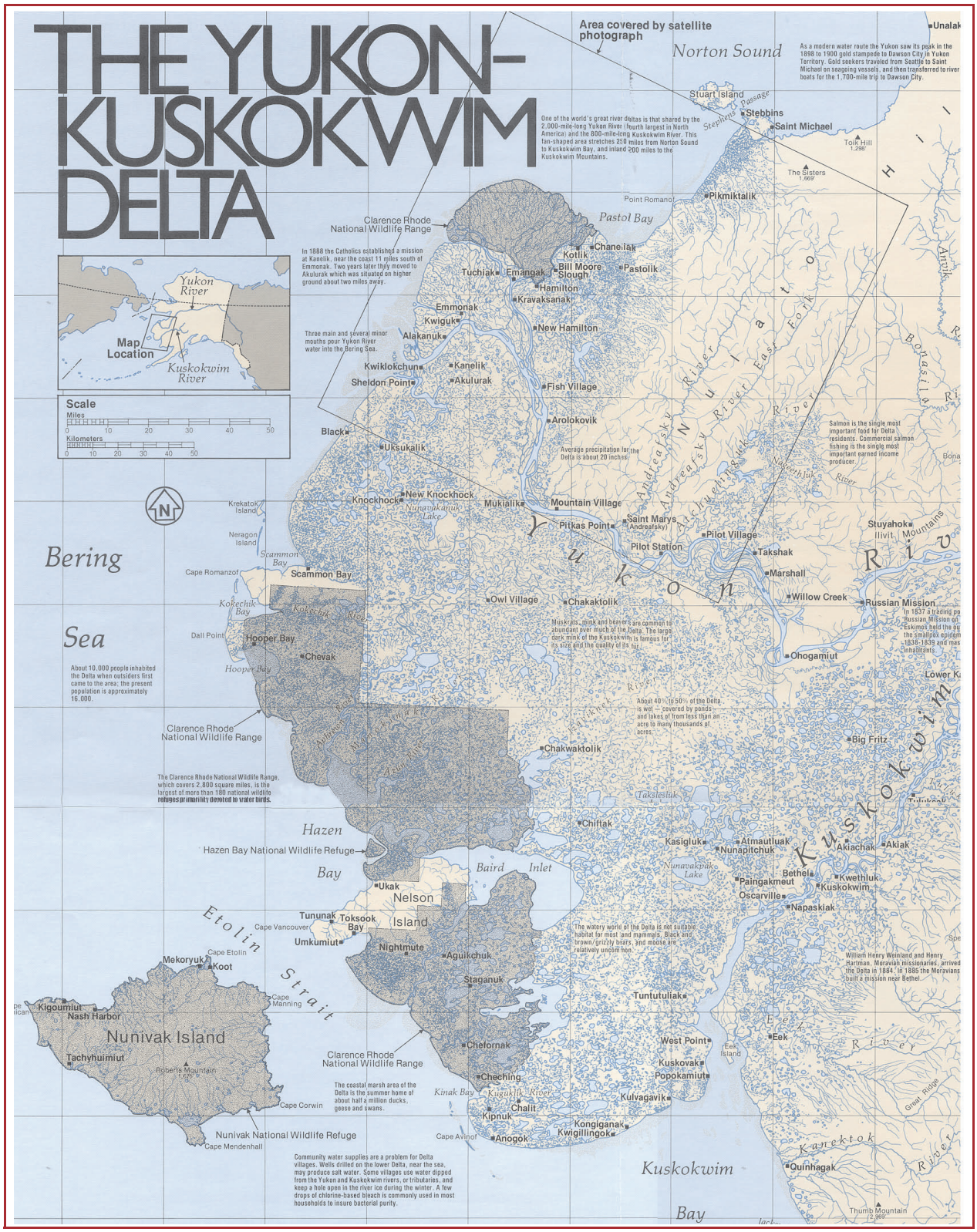


Figure 1-3 River Delta Area Wetlands (Courtesy Alaska Geographic Society)

Fish and wildlife habitat can also require special construction considerations in some areas of the tundra/coastal areas. The coastal area is the most important nesting area on the North American continent for migrating geese. Many species of ducks, including eider, inhabit the region seasonally. The Y-K Delta shorebird habitat is also without equal in North America during the summer. Beaches, sea cliffs, tundra, and willow-lined streams provide habitat for a variety of small birds.[2]

Figure 1-4 Typical Tundra Village - Atmautluak (FAA, Alaska Region)

Seal, walrus, and beluga whale are abundant and are an important food source for the people in the region.

Fish harvested throughout the year include all five species of Pacific salmon, whitefish, sheefish, rainbow trout, pike, halibut, Arctic char, Dolly Varden, blackfish, and on the coast, several types of shellfish.

Figure 1-5 Coastal Village - Hooper Bay in Winter (AK DOT&PF)

Caribou and moose are also important food sources. Other land mammals include black bear, grizzly bear, wolves, wolverine, and musk ox. Smaller animals include fox, otter, mink, marten, weasel, lynx, beaver, muskrat, and snowshoe and Arctic hare.[3]

Figure 1-6 Ocean-Going Barge at Bethel (AK DOT&PF)

2. Lydia L. Selkregg (editor), *Alaska Regional Profile*, Volume III, "Southwest Region," 1975.
3. Ibid.

Upriver Area

The other distinct area of the Y-K Delta is the upper Kuskokwim River. The area begins as low rolling hills and plateaus (Figure 1-7) rising first to the Kuskokwim and Kilbuck Mountains and eventually to the Alaska Range. This area has a number of small villages (20) generally situated on or near the banks of rivers. While the area is underlain with intermittent permafrost, the better draining soils and terrain are much more suited to standard construction techniques than the coastal areas.

Figure 1-7 Kuskokwim Mountains (AK DOT&PF)

The upriver area is well forested primarily with spruce, birch, and other trees that provide shelter for moose and other game during the winter. The area has most fish and wildlife species found in the tundra/ coastal area with the addition of Dall sheep. Unlike the coastal area, wood for heating, cooking, and construction of log structures is plentiful in this area.

The difficulty of getting fuel oil to these remote villages by barge led to an examination of village runway lengths in order to assess improvements needed to bring fuel in by large aircraft. Shallow waters above Stony River on the Kuskokwim River tend to isolate McGrath, Takotna, Nikolai, Telida, and the area's significant mineral development potential. The U.S. Army Corps of Engineers (USACE) studied the upper reaches of the Kuskokwim River in 1997[4] and concluded that any large-scale river-borne commerce upriver of Stony River is unlikely. The study also reports that there are no practical projects to improve navigation at three shallow spots in the upper river.

An essential feature of this area is its extensive mineralization. Colorado Creek, Nixon Fork, Donlin Creek, Stuyahok, Reef Ridge, and Shotgun Hills are potential mining areas. Reef Ridge, a Doyon Corporation property, appears to have a significant deposit of zinc oxide, and Donlin Creek, a Calista Corporation property, is a world-class gold mine (more than 6.7 million ounces) near Crooked Creek. A 12-mile road to the Kuskokwim River allows small barges to move construction materials and fuel to the Donlin Creek site for a first generation of development, but like the rest of the area, large-scale development would benefit from access to the Yukon River.

Mining for gold, silver, lead, zinc, antimony, tungsten, tin, copper, and nickel, especially around Malemuta, Cirque, Independence, Golden Horn, Tolsti, Vinasale, and Granite Mountain, are also potential development opportunities. Mercury has been mined at Red Devil.

4. U.S. Army Corps of Engineers, *Expedited Reconnaissance Report and GIS Database—Kuskokwim River*, September 1997.

There is a world-class platinum deposit at the southern end of the same geological zone near Platinum/Goodnews.

Figure 1-8 Road leading South out of Ruby (FAA, Alaska Region)

1.2.2 People

The region's Yup'ik and Athabaskan are descended from people who crossed the Bering Land Bridge during the Ice Age, between 20,000 and 15,000 BC. Yup'ik settled first along the Bering Sea coast and later along the lower and middle reaches of the Yukon and Kuskokwim Rivers, living on an abundant supply of fish, sea mammals, and waterfowl. The Athabaskan moved across the land bridge and into interior Alaska living on the region's natural resources. Both Yup'ik and Athabaskan developed extraordinary skills in fishing, hunting, trapping, and gathering, creating a subsistence-based culture that is still central to life today. Yup'ik villages generally evolved from seasonal subsistence camps. The shift from nomadic lifestyle to more permanent settlements occurred as European traders and missionaries moved into the region. The first contact between Yup'ik and Europeans occurred in the late 18th century when Russian explorers came to the Y-K Delta.[5]

Soon after these contacts, Russian fur traders and Catholic Orthodox missionaries set up trading posts and missions along the coast and rivers. The interaction between these Russian groups and the Yup'ik was generally not disruptive to the traditional Yup'ik lifestyle[6] and trade was generally friendly.

In the winter of 1838-1839, foreign-origin smallpox swept through the region, killing 50% or more of the approximately 7,000 residents, both Yup'ik and Athabaskan. The epidemic was more severe on Athabaskan and some of their upper Kuskokwim River groups became extinct after the few survivors married into Yup'ik groups.[7] Later epidemics (1900 and 1918) devastated many coastal villages.

Epidemics in 1838 and 1900,[8] missions and schools established at certain sites, in-migration of non-Natives, and the start of a cash economy combined to encourage permanent villages.[9]

5. Lydia Black, *Yup'ik of Western Alaska and Russian Impact*, Inuit Studies, 1984.
6. Wendell Oswalt, *Settlements along the Kuskokwim River, Alaska.*
7. Nicole McCullough, *Permanent Places*, Unpublished, available at DOT&PF, 1998.
8. Wendell Oswalt, *Settlements along the Kuskokwim River, Alaska.*
9. Nicole McCullough, *Permanent Places*.

The Moravian missionaries, who had roots in central Europe, arrived during the last two decades of the 19th century to establish mission stations at most of the river communities along the Kuskokwim River. The Moravian impact on the Yup'ik traditional lifestyle was more dramatic. In addition to religious conversion, Yup'ik and Athabaskan were taught to adopt the Western lifestyle; more important, traditional dances were banned, and marriage and household living arrangements were changed.[10]

In 1885, Moravian missionaries founded Bethel across the river from the small Yup'ik community of Mamterillermiut.[11] In 1891, Bethel had less than 30 residents; by 1940, the population had slowly grown to 400 people. The number of prospectors, storekeepers, missionaries, and workers in sawmill and transport-related occupations grew in response to the growth in commercial, religious, and governmental activities.

World War II and the resulting "discovery" of Bethel swelled Bethel's population to about 1,260 in 1960. Forty years later, in 2000, Bethel had a population of 5,471. This rapid growth reflects natural population increases, in-migration from other villages, and in-migration from outside the region that has been stimulated by increased private and government sector jobs. Table 1-1 shows the rapid growth of the overall Y-K Delta region over the last fifty years. The DOT&PF analysis, based on cohort and regional health data, shows this trend will continue especially in Wade-Hampton, one of the fastest growing census areas in the nation.[12]

Table 1-1 Population Growth for the Y-K Delta — 1950 to 2000

Census Area	1950	1960	1970	1980	1990	2000	50 year Annual %
Bethel City	651	1,258	2,416	3,576	4,674	5,471	4.34%
Bethel Census Area (w/o Bethel City)	3,116	5,203	6,149	7,247	8,901	10,525	2.12%
Wade-Hampton Census Area	1,441	2,165	3,584	4,537	5,774	7,028	3.22%
Yukon-Koyukuk (Holy Cross/ McGrath) Subarea	661	911	994	1,227	1,405	1,319	1.39%
Total	**5,869**	**9,537**	**13,143**	**16,587**	**20,754**	**24,353**	**2.89%**
Source: Alaska Department of Labor and Workforce Development and 2000 Census							

10. Alaska Geographical Society, *The Kuskokwim,* Anchorage, Alaska, 1988.
11. M. Lenz, J. Barker, *Bethel—the First 100 Years, 1885-1985*, Bethel, Alaska, 1985.
12. 2000 U.S. Census.

In 1971, Congress passed the Alaska Native Claims Settlement Act to help set the stage for the oil field developments at Prudhoe Bay. The act created for-profit corporations at the regional and village level to help Alaska's indigenous people prepare for the future. The regional corporations also include non-profit corporations that have become the major connection between many federal programs and the tribal government in each village. Calista Corporation, the Y-K Delta for-profit organization, has 13,000 shareholders and 6.5 million acres of land. Corporate holdings include mining, computers, and publishing. Doyon, Limited, the other regional corporation that borders the Y-K Delta (including the middle Yukon area), has about 14,000 shareholders and 12.5 million acres of land. In addition to an oil field service company and other commercial interests, it also has several mine sites in or near the Y-K Delta study area.

Contemporary life in the Y-K Delta is a blend of traditional ways and efforts to develop sustained cash economy elements at the regional and village level. Construction jobs and business opportunities provide one avenue for a better economy in the region.

While some Yup'ik and Athabaskan move from smaller villages to larger communities or from the Y-K Delta to urban Alaska for education, jobs, and other activities, Yup'ik and Athabaskan populations have grown steadily since 1940. This is due to reductions in infant mortality, relatively high birth rates, and an increase in life expectancy. Population growth is expected to continue at about 2% a year for the next 20 years.[13]

Figure 1-9 Residents of Alakanuk Preparing Fish (DCED)

Today, although methods and tools for hunting, fishing, and gathering have changed, people in the region have recaptured and retained their traditional ways of life. Subsistence harvesting and sharing of the harvest is widespread and of critical importance economically and culturally; Yup'ik and/or Athabaskan is still spoken in all communities.

The emergence of dance festivals like the Camai, held in Bethel each spring, are reinforcing the joy and value of traditional dances and stories, and bilingual programs in schools help pass the Yup'ik language on to the children.

Rifles, boats equipped with outboard engines, commercial nets, snowmachines, radios, and Global Positioning System (GPS) instruments use is widespread, but the hunting, fishing, and gathering techniques behind the tools still reflect traditional ways. It is clear that the people

13. See Appendix A, Y-K Delta Population Projection using a Cohort Survival Model, 1995–2020.

of the Y-K Delta, while struggling as all people do, are successfully incorporating new ways into traditional ways.

They continue to teach their youth traditional values, which include integrity and respect for the Elders as core values.

The Y-K Delta Plan reflects an effort to select transportation network improvements that meet present and future transportation demand based on traditional values and village preferences.

Figure 1-10 Dancers at 2001 Camai Festival (www.bethelarts.com)

1.3 Y-K Delta Plan Document

Y-K Delta Plan sections and the appendices that support the plan are briefly described below.

Section 1. Introduces the reader to the plan and some of its main issues, outlines the planning processes, and introduces the reader to the land and people of the region.

Section 2. Describes existing transportation facilities and services and outlines conditions that affect transportation operations in the region.

Section 3. Describes the existing aviation system and the models developed to analyze future aviation demand and outlines a development plan for the region's 53 airports, including runway dimensions and construction timelines. The section incorporates the results of continuous discussions held with the FAA, air carriers and others in the aviation community. The analyses in this section confirmed the need for all village airports to meet a 3,300-foot runway standard and indicates those airports that need 4,000- to 4,500-foot runways during the 20-year plan horizon.

Section 4. Describes trail-marking needs for winter trails between villages and from villages to major subsistence areas. It includes a new tripod marker design that is based on local knowledge and elements like signage, locator beacons at tundra villages, and other components needed for an adequate trail marking system. The plan also confirms

DOT&PF practice that trails will primarily be located and constructed by people from the villages being served by the trails.

Section 5. Describes road construction opportunities and constraints in the region. The section outlines road corridor analyses requested by villages during public meetings. Overall, intervillage roads in the tundra and coastal areas of the Y-K Delta are not cost effective. This is due primarily to wetlands and soil conditions as well as the absence of nearby construction materials. The section also includes discussion of a road from Ruby to mine developments at Reef Ridge and Donlin Creek with a connection to McGrath. The section concludes with a commitment to do a Benefit/Cost Analysis for the corridor as part of the Northwest Alaska Transportation Plan currently underway.

Section 6. Describes the background and results of the recent U.S. Army Corps of Engineers (USACE) Bering Sea Port study. The section also proposes consideration of inexpensive barge landings for improving river village dockage throughout the area. The section also looks at potential docking facilities for hovercraft delivering mail to villages near Bethel.

Summary. Bound into the plan, the Summary was printed as a separate, stand-alone document useful for briefings and for discussions with legislators, government agencies, and the residents of the region.

Appendices. Appendices are bound separately from the plan. They can be ordered from DOT&PF. They include databases and modeling information[14] used to conduct analyses of transportation systems and system demand. Appendices are outlined in Table 1-2.

14. Data were obtained on socio-economic conditions on a village by village basis. These data appear on web sites for the Alaska State Department of Community and Economic Development and the Department of Labor and Workforce Development.

Table 1-2 Y-K Delta Regional Transportation Plan — Appendices

Appendix Title		Description
A.	Population Projections and Review	The 2000 census showed that the cohort analysis in Appendix A, which uses 1990 data plus a combination of information from the Y-K Regional Health Corporation, was on the mark. The results affect many elements of the plan including population-dependent enplanement and mail forecasts.
B.	Air Transportation Passenger Demand Forecast	Analyzes aircraft movements in the region and applies a planning logistics model to forecast future enplanements.
C.	The United States Post Office's Bypass Mail System	This report provides background on the unique fourth-class mail delivery system that provides mail service to remote communities in Alaska. This system has a large influence on transportation operations and passenger fares paid for bush travel.
D.	USPS Mail Demand Forecast	Analyzes and forecasts the demand for air transport of Bypass mail.
E.	USPS Supply Modeling Options	This is a simulation undertaken to understand the implications of growing mail volumes and changing air fleet on mail delivery patterns, including the advantage of more postal hubs and mainline routes.
F.	Yukon-Kuskokwim Delta Coast Regional Port Study	This study reports U.S. Army Corps of Engineers (USACE) findings relative to the benefits and costs of a new regional port along the Bering Sea coast. The results indicate that such a port would not be cost effective using Corps national criteria.
G.	Ruby to McGrath Road Feasibility Study	The city of Ruby commissioned a preliminary study of a potential road alignment from Ruby to McGrath in 1993. With the approval of Ruby, the study, without one set of oversized maps, is provided as background material.
H.	Bulk Fuel Distribution and Delivery	This report outlines difficulties barges have accessing some villages, the limited fuel tank storage capacity at many villages, and problems with aging storage tanks.
I.	Hovercraft Technology and Its Use	This work provides an assessment of hovercraft, now an operational piece of the transportation system in Bethel. It includes a discussion about the need for docking structures to enhance riverbank operations.

Section 2. Transportation in the Y-K Delta

The Yukon-Kuskokwim (Y-K) Delta is the 70,000-square-mile watershed of two major rivers—the Yukon River and the Kuskokwim River (Figure 2-1). The mountain communities of Lime Village and Telida on the slopes of the Alaska Range are on the eastern boundary. The delta extends west to Mekoryuk on Nunivak Island in the Bering Sea and along the Bering Sea coastline from Platinum at the extreme southern end of Kuskokwim Bay north to Kotlik on Norton Sound.

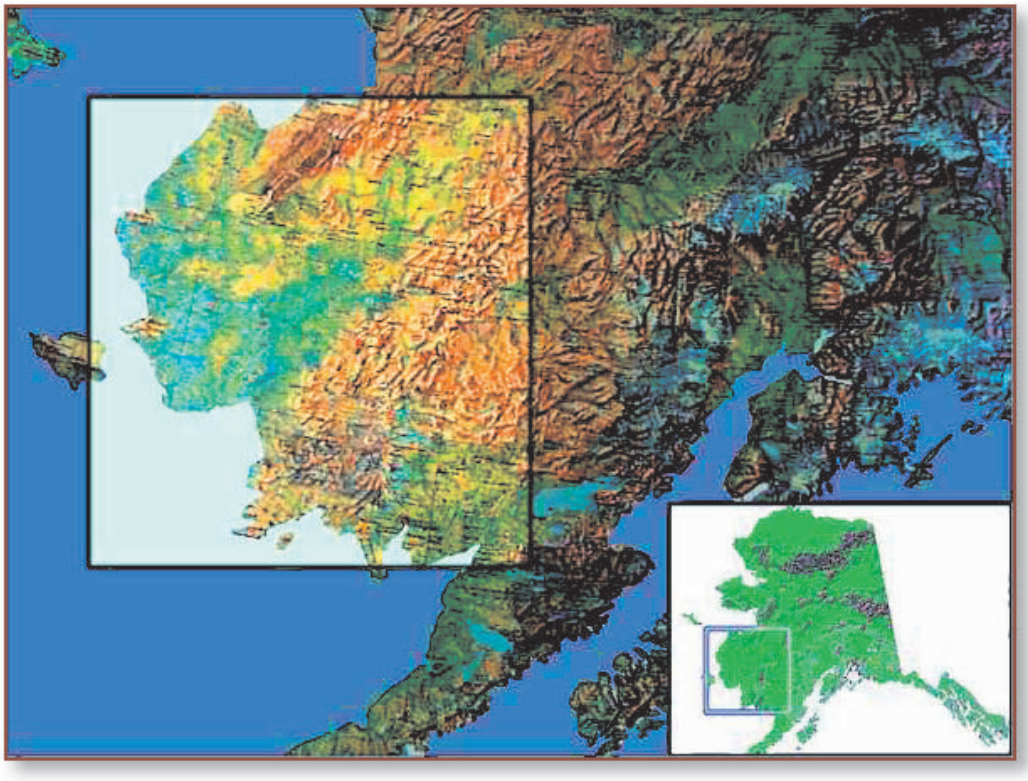


Figure 2-1 Yukon-Kuskokwim Delta (FAA)

2.1 Conditions Affecting Transportation

This region is home to about 25,000 Alaskans, mostly Yup'ik with some Athabaskan in upriver communities, and about 4,000 non-Natives. These 25,000[1] inhabitants combine cash and subsistence activities to forge a livelihood in 54 small villages distributed throughout the region. Bethel, with a population of about 5,500, is the largest community and the region's social and commercial hub.

1. 2000 population data by race, sex, and age for the census areas in the Y-K Delta are available from the U.S. 2000 Census.

Factors that influence the character of the region's transport system include:

- Remote geographical location
- Relatively long distances between villages
- Wetland/permafrost soils
- Harsh winter climate
- Lack of good transport infrastructure building materials
- Village settlement patterns
- Land management patterns
- Relatively small cash economy
- Rapidly growing population
- Evolving transport technology
- Government policies

Transportation in the Y-K Delta is extremely seasonal as Figure 2-2 shows. Air travel is the only year-round transportation. In the winter, people use snowmachines on winter trails to access neighboring villages and hunting and fishing sites throughout the region. People use cars and trucks on limited ice roads near Bethel.

In the summer, skiffs and small boats provide basic transportation; barges supply almost 22 million gallons of fuel products and the region's heavy freight; and ocean barges are bringing in an increasing amount of container freight to the Port of Bethel.

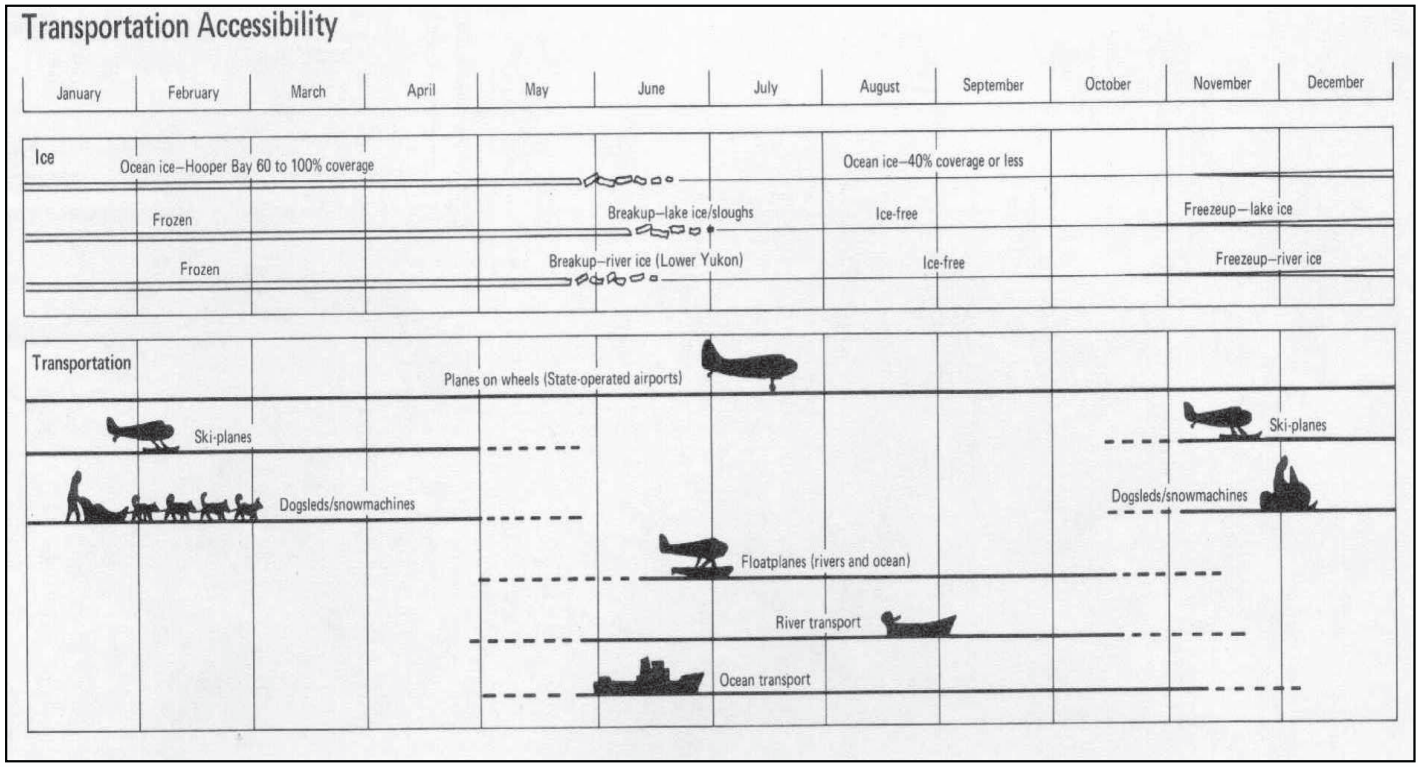


Figure 2-2 Modes of Transportation Accessibility for Hooper Bay

An AP1-88 Hovercraft has recently been employed by the United States Postal Service (USPS) to deliver mail to seven villages near Bethel. It also carries some passengers. The hovercraft can operate in all weather on land and on the water. During the periods known as freeze-up and break-up, aircraft are the only practical way to travel between villages.

The climate is primarily continental, transitional in the upriver areas and maritime from Bethel seaward toward the coast. In the summer, the prevailing wind from the south and the west brings in marine moisture from the Bering Sea. Most of the annual precipitation of about 20 inches falls in the summer. In the winter, the Delta is under the influence of the semi-permanent high pressure systems over Northern Canada and Siberia, and the prevailing northerly and easterly winds usher in cold, dry arctic continental air. Hazardous winter travel, particularly during the whiteouts prevalent throughout the area, is caused not so much by heavy snowfall as by blowing snow associated with strong winds or by fog, which often accompanies sudden changes in temperature.

River break-up and freeze-up are essential indicators of the seasons. Freeze-up generally occurs in late October or early November, and break-up generally occurs in early to mid-May. Mean maximum temperatures in July range from the upper 60s°F in the interior to mid-50s°F along the coast, and the mean minimum temperatures in January are generally near 0°F along the coast becoming colder in the interior.

Break-up on the Kuskokwim River, once it begins, takes only a few days until the ice is gone. On the longer/wider Yukon it can take several weeks for the ice to clear, resulting in a shorter barging season.

2.2 Existing Transportation Facilities and Services

2.2.1 Hub and Spoke System with Bethel as Regional Hub

The City of Bethel is home to about 5,500 people, approximately 22% of the region's 25,000 inhabitants. It is clearly the social, cultural, health, and transportation center of the region. Bethel has the only medium-draft port facility in the region, receiving small ships and ocean-going barges. It serves as the transshipment point for river barge traffic to the villages on the Kuskokwim River and to some extent along the coast.

Bethel is the location of the Regional Hospital and numerous state and federal regional offices. It meets the hub model standard—it has a much larger population than any of the surrounding communities, it is the administrative center, and it has a relatively complex transport system.

Bethel's airport is a full-service jet facility. With over 125,000 annual enplanements per year, it is the fourth busiest airport in the state. Alaska Airlines provides daily service to Anchorage on three combination passenger and cargo B-737 jet aircraft. As a hub, the airport is the connection point to 26 of the region's

villages and is the transshipment point for over 20 million pounds of mail and air cargo per year.

The remaining villages are served by much smaller hubs at Aniak (10 villages), St. Mary's (3 villages), McGrath (10 villages) and Emmonak (4 villages). Aniak also receives some small jet service from Anchorage. McGrath and St. Mary's have had jet service in the past, but the airports were decertificated in 1996 when air carriers discontinued passenger jet service.[2] The airports can no longer accommodate large passenger jets.

2.2.2 Air

There are 53 state-owned airports in the Y-K Delta served by passenger airlines, cargo carriers, and air taxis. They provide year-round passenger, freight, and mail service to the communities in the region. When the study started, only 26 of the region's runways were 3,300 feet or longer, which is new minimum runway length for state-owned airports.

As the result of an aggressive DOT&PF airport reconstruction program, all deficient airports in the region are scheduled for runway upgrades within five years.

The USPS plays an important role in the airport system in the Y-K Delta delivering fourth-class mail to the remote bush communities by air transport where no roads or alternative ground transport methods exist. Through its mail system, the USPS provides a consumer products distribution system from wholesalers in Anchorage to stores and schools in the region's villages. This service, established by federal statute,[3] provides low cost, year-around, regular delivery to villages at about 50% of the barge cost, without the need for 9 months of inventory.

Today, when simply mailing a fourth-class package across the counter at Post Office rates, the cost to the consumer is about 40% lower than shipping by air freight. When using Bypass mail (described below) the cost of mailing is about 40%-60% of the equivalent shipping by air freight.[4]

The USPS "Bypass" system for providing mail to the remote bush communities is unique. The goods are ordered, generally by a store, from a distributor in increments exceeding 1,000 pounds (the average order is about 3,500 pounds). The distributor consolidates the order onto pallets and delivers it to a mainline air carrier where it is accepted for transport under the authority of a postal inspector. The mainline air carrier delivers the pallets to a hub airport. The Y-K Delta hub airports are at Bethel, Aniak, St. Mary's, McGrath, and Emmonak. There, pallets are broken down and the goods are transshipped by small aircraft to village stores or institutions that placed the orders.

2. Fire-fighting equipment and other safety items, plus the personnel to operate them, were removed as a cost saving, thus these airports no longer meet the provisions of 14CFR139.
3. Established by law (39USC5402), the United States Postal Service is required to perform their mail delivery mission of "providing universal service at universal rates" in Alaska including to the remote, rural communities.
4. Approximate data is from Mr. Butch Hallford, Northern Air Cargo.

The Bypass mail volume (47 million pounds to the region in 1999) requires small air carriers to schedule frequent flights to complete delivery in a timely fashion. At one time, this level of air traffic promoted less expensive passenger travel. However, recent changes in air carrier businesses have had adverse affects on passenger service. Large insurance rate increases in 1998 for air carriers carrying passengers caused many small air carriers to become "mail only" carriers. In addition, "mail only" carriers have increased their base of operations. Under the equal tender provisions of the Bypass mail system, this has reduced the level of mail for those air carriers still carrying passengers. This trend is resulting in higher passenger fares as the remaining passenger/mail air carriers shift more costs over to the passenger side of their operations.

Getting in your car to shop, to go to the hospital, to take your sports team to a basketball game, or to take your class to the museum can only be done by air in the bush.

Villagers travel by plane, mainly to Bethel and Anchorage, for medical treatments, education, government services, and to visit relatives, among other reasons. Enplanements, the number of passengers boarding aircraft, for all airports in the Y-K Delta has increased at an average rate of 4% per year this decade—from just under 10 boardings per person in 1990 to nearly 11 boardings per person in 1996. From 1997 to 1999, enplanements per person declined back to about 10, due to a reduction in village income, resulting largely from the poor fishing harvest in 1997 and 1998. However, the area continues to grow and with presumed resumption of fish harvest, the earlier rate of increase should resume.

Passenger and mail transport demand is expected to increase by 3 to 5 percent per year over the 20 years of the plan. The present fleet of single-engine, small aircraft like the Cessna 206 and 207 in use throughout the region will be replaced with larger aircraft on the longer and/or higher volume routes. With larger aircraft comes the need for longer runways.

Flying from visual flight rules (VFR) into instrument meteorological conditions (IMC) often occurs while aircraft are enroute. The Federal Aviation Administration is undertaking testing new equipment in the region to improve flight safety in these conditions. Project Capstone[5] aircraft are being equipped with new electronics and more airports are receiving automatic weather sensing systems to improve navigation, air-to-air data transmission, and in-flight collision avoidance. In addition to the program of improved aviation navigation, DOT&PF is committed to a runway lighting program to enhance safety and improve airport accessibility throughout the system.

5. Alaskan Region Capstone Program. See the FAA website/Alaskan Region at www.alaska.faa.gov.

Figure 2-3 Boardwalk in Nunam Iqua (DCED)

2.2.3 Land

There are few roads in the region. The delta's fine-grained soils; consistent pattern of small lakes, ponds, and wetlands; and the absence of local aggregates make road construction and maintenance exceptionally expensive. The permafrost, which underlies most of the region, adds to the challenges and costs by requiring special soil and base preparations.

In most Y-K Delta villages transport is by all-terrain vehicles (ATVs) on village roads or boardwalks. Even in those few cases where roads have been built, it is difficult to keep them open in the winter. The notable exception is the 23-mile road between St. Mary's and Mountain Village (1,500 residents). The road is currently scheduled for major repair in 2004.

Other roads in the region are either short, like the 3-mile road connecting Upper Kalskag with Lower Kalskag, or are local roads designed to access landfills, sewage lagoons, and airports. Most roads are presently not paved, although dust control (using paving with chip and seal) are becoming important local road projects.

In the winter, people travel direct routes overland with snowmachines to villages and to hunting and fishing sites. In the Bethel area people also travel by car/truck on the Kuskokwim River ice road, generally as far north as Aniak and as far south as Eek. As snowmachines have become faster and more dependable, winter trail travel has taken on added importance in the region's transportation system. The department has committed to an aggressive program of marking winter trails.

2.2.4 Water

Barge and boat travel is the primary means of transportation in the Y-K Delta during the ice-free season, generally between May and October. In the season between break-up and freeze-up, the rivers and their tributaries and sloughs become highways that carry people and goods on short and long trips throughout the region.

The few docks, ramps, and mooring facilities are used for freight and fuel delivery. Elsewhere, barges work from unimproved riverbank and coastal landings. Conditions are extreme by any comparison with normal maritime operations. Ice-free summer shipping seasons are short; distances are long; coastal waters are shallow; and shoals are constantly changing. Navigation aids and charts are basically non-existent.

Figure 2-4 Nunam Iqua Small Boats (DCED)

Y-K Delta residents engage in extensive travel in summer by small boats (generally up to 22 feet) in the region's rivers and along the Bering Sea coast for commercial fishing, subsistence fishing and hunting, and for gathering greens, berries, and other resources. As boats have become larger and motors more dependable, open water travel has become more common over longer distances. However, the absence of adequate ports and harbors in the region continues to limit boat sizes in ways that expose travelers and fishers to extreme danger during sudden changes in weather and sea conditions.

In addition to local fisheries, twenty-one coastal villages participate in Community Development Quota (CDQ) programs. In the 1990s, the federal government allocated a share of the Bering Sea catches of crab, groundfish, halibut, and sablefish to 65 villages on or within six miles of the coast. These villages were organized into six groups, each with an approved fisheries development plan. The six groups established operating partnerships with large commercial fishing companies that operate in the Bering Sea. The companies hire local residents, and the villages use a share of their profits to buy vessels, establish loan programs, build processing plants, and set up employee scholarship and training programs.

Figure 2-5 indicates the twenty-six villages from the study area that participate in the CDQ program. Fully realizing the CDQ potential would require small boat harbor improvements along the coast that would allow residents to bring in larger, more capable boats.

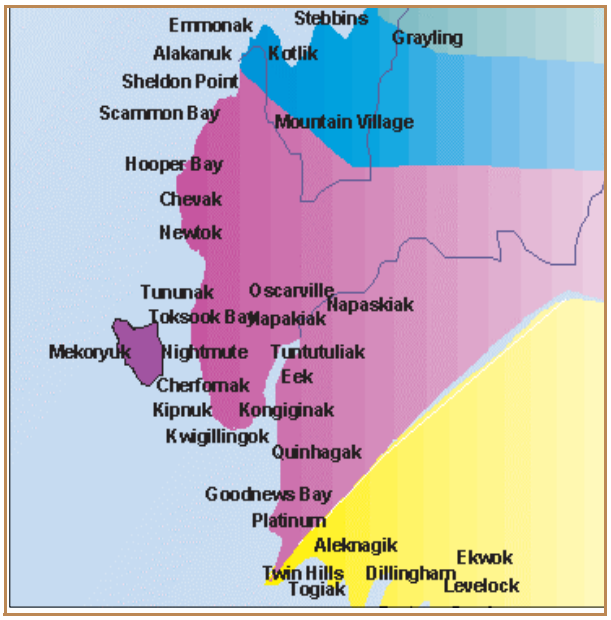


Figure 2-5 Community Development Quota (CDQ), Yukon-Kuskokwim Delta Communities

Bulk fuel and freight are delivered by barge to the riverine and coastal communities. Oceangoing petroleum barges, with a capacity of 3 million gallons each, carry fuel to the study area. Oceangoing roll-on/roll-off freight barges carrying as much as 50,000 tons of cargo call at Bethel. Smaller barges, carrying 50,000 gallons of fuel and freight, deliver to villages along the rivers and coast. Many carry fuels from the major fuel depot in Bethel while those on the coast lighter fuel transferred directly from oceangoing barges standing offshore.

Almost all the fuel consumed in the Y-K Delta is distributed by barge. At times, when weather or low water conditions restrict fuel barges, or when severe winter weather depletes fuel supplies, fuel is flown into villages at prices about three times the per gallon price delivered by barge (as described in Appendix H). One alternative being pursued by DOT&PF is constructing 4,000-foot runways at villages like Lime Village, Nikolai, and Takotna where barge service is not available, so fuel can be flown in with larger aircraft at lower per gallon prices.

The banks of many river villages are eroding and some are unreachable by the small barges used on the Kuskokwim River or the lower Yukon. Shallow water near landing areas, lack of any mooring facility on the bank or in the river means that barges are held in place by tugs, while the cargo (usually fuel oil) is off-loaded. This often means extra-long hoses for fuel or long wooden planks for cargo, and sometimes it means that the best loading spot may be several hundred yards or more away from the appropriate landing spot. Sometimes landing is not possible in very low water. In such cases, barge operators wait for hours or days for the river to rise. In addition to the economic loss, there is also a potential safety hazard for the barge crews as well as an environmental risk if fuel products leak into a river or on a beach. Several entities are working with the region's barge operators and tank farm owners on cost effective solutions to these transfer issues.

2.2.5 Hovercraft

During the development of the Y-K Delta Plan, the USPS conducted an experiment using an AP1-88 Hovercraft to deliver Bypass mail to eight river communities (combined population of about 5,000) within about 20 miles of Bethel. USPS conducted an Environmental Assessment to determine the hovercraft's effects on fish, wildlife, and residents while operating on the area's rivers. At the completion of the studies, and in spite of some village reservations, a "Finding of No Significant

Impact" (FONSI) was issued and the hovercraft will continue to deliver mail through 2006.[6]

Figure 2-6 Unloading Hovercraft in Napakiak (DOT&PF)

An air cushion vehicle (ACV), the hovercraft moves on water or land. It has proven well suited to transport mail and freight and it has played a role in several search and rescue operations. Yet it continues to face opposition from some villages because of concerns about impacts on fish and wildlife and noise levels that local people perceive as high and/or intrusive.

The landing places being used by the hovercraft are not conducive to off-loading and short term storage. Complaints about the condition of delivered goods have been received. For these villages, a simple pad might be useful to improve the condition of the goods and the ease of future delivery. More sophisticated structures would include docking facilities allowing pallet-based roll-on/roll-off operations.

2.3 Summary

This section outlined economic challenges and unique environmental conditions that confront transportation infrastructure and service providers in the Y-K Delta.

Most infrastructure improvements are very expensive. The region has extensive permafrost and generally poor soil conditions. Construction equipment and material frequently needs to be barged in, and construction often takes several seasons. Terrain and soil conditions generally preclude inter-village road construction from being a major cost effective transport alternative in the region's tundra and coastal areas.

Other major environmental influences on transport operations include weather, especially the severe winter storms that close airports and cause whiteout conditions on winter trails; and coastal/river conditions that are continuous problems for fuel and freight barge operations.

Nonetheless, population growth, growing health care travel, education and business travel, and a projected doubling of fourth-class (Bypass) mail volumes all lead to increasing air transport demand. Faster, more durable snowmachines and skiffs increase personal travel demand on the region's winter trails and rivers. In

6. The USPS has executed a contract with the Lynden Company to continue hovercraft delivery through the year 2006.

addition, CDQ offshore fishing opportunities and assumed improvements in river salmon runs, job opportunities in health care, and increasing employment in construction projects help to diversify and stabilize village economies, also contributing to increases in travel.

So, despite the challenges, improvement to transportation is a critical element in both meeting demand and assisting development of the region. Meeting transportation demand involves both improving existing facilities and developing new access. DOT&PF capital project programs, the recently established Denali Commission, the Bureau of Indian Affairs road programs, and other funding sources will address many of these needs.

Special funding may be needed to address the major concern of dust control on village roads that was revealed during the planning process. Attempts to develop an industrial corridor to the mining districts in the Ruby to McGrath area will also take special funding considerations, including private-public partnerships with the region's mining industry.

Finally, to move quickly, infrastructure development agencies need the support of city and tribal governments, as well as the support of the region's regional and village Native Corporations and non-profit corporations.

Section 3. Y-K Delta Aviation Plan

Analyses in the Y-K Delta Plan examine air travel patterns, forecast future demand, and examine public policy affecting aviation operations in the Y-K Delta. The goal is to understand infrastructure and policy requirements for a modern air transport system that increases safety, enhances mobility, facilitates freight and mail movements, improves air carrier productivity, and in some cases, lowers product costs.

To reach the infrastructure improvement element of the system, DOT&PF will need to make an investment of almost $300 million over the next 20 years to upgrade the airports in the Y-K Delta. It also will require concurrent private investment in improved aircraft and pilot training. Small, inexpensive airport shelters also need to be addressed as part of plan implementation. When combined with the Federal Aviation Administration's (FAA) "Project Capstone," implementing the Plan's model can improve aviation safety, airfreight operations, and potentially reduce passenger fares. Combined with policy changes at the U.S. Postal Service (USPS) and the U.S. Department of Transportation, the infrastructure improvements can also enhance delivery of fourth-class mail.

3.1 Air Transportation in Y-K Delta

Aviation is the transportation lifeblood of the Y-K Delta. It is clear from analyses that if DOT&PF provides adequate infrastructure and the FAA continues to improve air navigation in the region, the private sector will provide safer and more efficient services.

Although the Y-K Delta aviation system works, and is safe, considering the large number of daily operations, it is cumbersome and inefficient. One major impediment to system efficiency is runway capability; the gravel runways can be exceptionally short and uneven with significant gradients, lack of lighting, and limited protection zones. DOT&PF is overseeing a system-wide upgrade to provide lighted runways at least 3,300 feet by 60 feet.

It is also clear that soon, larger and more sophisticated aircraft will come on line to satisfy the region's growing air travel and mail/freight demand. Operations to date have been largely by small single-engine and twin-engine aircraft operating under Part 135 of the Federal Air Regulations (under ten passengers and one pilot) flying visual flight rules (VFR).

The FAA is enhancing aircraft safety with new avionics technology (through the Alaskan Region Capstone program) that provides non-precision instrument landing capabilities and improved understanding of airspace occupancy and weather, which will improve safety and flight reliability. Turbine aircraft are beginning to displace piston engine aircraft throughout the region. Air carriers will move toward

become FAR Part 121 carriers by adding 19-seat aircraft with 2 pilots within the 20-year planning horizon.

3.1.1 U.S. Postal Service (USPS)

USPS is a major agent transporting airfreight in rural Alaska, moving fourth-class mail to the villages. The cost to do this is much greater than fourth-class mail delivery costs in the rest of the United States, but the customer pays the same. This results in a significant deficit (>$100 million) in the USPS annual operating budget. As a result, USPS is continually looking for ways to save money and improve product quality. These efforts have resulted in added hubs (Emmonak in the Y-K Delta), better management of the "equal tender" provision, and the use of a hovercraft to deliver mail to villages near Bethel. In the future, larger aircraft and improved airport infrastructure will be important elements in improvement of and cost reductions for the USPS mail delivery system.

Recent challenges include increases in insurance rates for the carriage of passengers, which have caused a number of carriers to reduce passenger service and become "mail/cargo-only" carriers. This has caused delivery delays in many cases and has reduced passenger transport opportunities.

Also, the "carrier's rate," a two-tier compensatory rate system based on mainline delivery costs from Anchorage/ Fairbanks–to–regional hubs and a similar rate structure for regional hub–to–village service, provides little in the way of competitive incentive between carriers. New rates are calculated every six months and issued as regulations by the U.S. Department of Transportation (USDOT). The rates are compensatory line-haul costs in dollars per ton-mile and terminal costs in dollars per pound delivered. They are based totally on carriers' actual costs (weighted at 90%).

Equitable tender combined with the fixed rate schedule, while helpful in maintaining a carrier base, stifles carriers from obtaining larger, more efficient aircraft. It is also now placing mail-only carriers in an advantageous position since they get an equal share and are not saddled with passenger related insurance costs. Further, the small aircraft are comparatively inexpensive to operate, yet they are paid a fleet-wide compensatory rate providing high profits to the small carriers not carrying passengers.

The large number of aircraft and the equitable tender provision also combine to increase delivery times on bush routes. The all-cargo carriers tend to fly only when necessary (sufficient load) rather than keeping their posted schedule. There is strong evidence that this also results in increasing passenger fares. As the mail demand increases and the potential for different aircraft increases, the USPS will need to adjust its operating policies. This is currently under consideration by the U.S. Congress (e.g., SB-1713).

3.1.2 Airport Improvements

Airport improvements in the Y-K Delta have lagged behind the rest of the State because of the very high cost of runway construction. These airports do not have the annual passenger traffic (10,000

enplanements) to obtain "Primary Airport" status[1] and are thus limited in funding for airport improvements.

Since most of the village airport sites are wetland/permafrost soils, finding sites close to a village is often difficult. When coupled with high mobilization expense and imported construction material, even the simplest gravel runway is very expensive. Typical estimates range from $5 to $8 million per airport. Maintenance of gravel runways in the region's icy/snowy conditions is also difficult and expensive. Improved snow removal equipment is needed at many of the region's airports.

3.1.3 Super Hub Model

Aviation operations in the Y-K Delta are consistent with the broad operation of a super hub as suggested in Figure 3-1. A super hub, generally associated with the dominant city in a region, becomes the region's travel center. There are a group of smaller towns at the hub's fringe, up to 30 or 40 miles away, that depend on the hub for most aviation activities. These towns often have a small, general aviation airport of their own. For airports close to the hub, unless they are reliever airports, the requirements for airport facilities and landing capability are minimal.

Further from the hub the dominance of the hub decreases. Larger towns and cities in the range of 50 to 100 miles from the hub need more capability to receive aircraft and cargo. At the edges of the major airport's service area, there is a need for even more air carrier capability. This model describes nearly all the airport systems in the world. It is also true of air travel in the Y-K Delta except, unlike many areas of the country, no roads are available to provide an alternate means of transport.

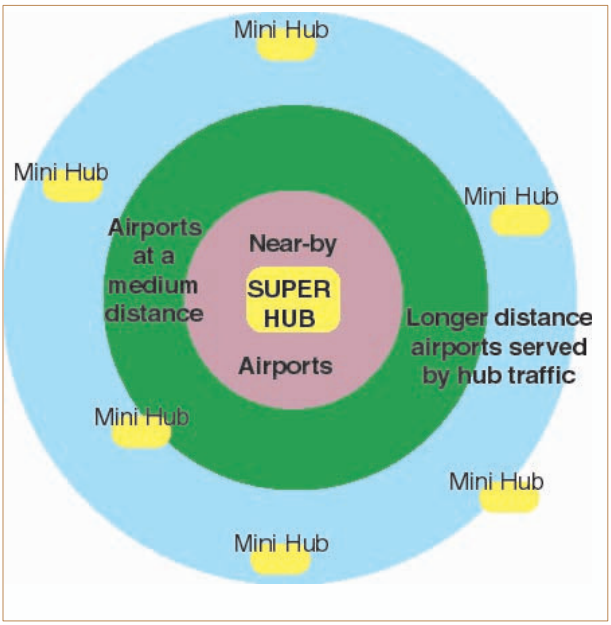


Figure 3-1 Typical Operation about a Hub

The major airport is Bethel. It is clearly the super hub of the Y-K Delta region. The towns nearest to Bethel often have some alternative service available, including boats, ice-roads, snowmachines, and the hovercraft. Air service, which at times is still needed to serve these cities, is less demanding because of short flight times, quick turn around, and often smaller loads.

Many villages along the Yukon River and on the upper reaches of the Kuskokwim River need or already have longer runways for larger aircraft. The larger

1. The FAA maintains the National Plan of Integrated Airport Systems (NPIAS) under Section 47103 of Title 49 of the U.S. Code. The 1998-2002 plan identifies 3,344 existing airports that are significant to national air transportation, containing the infrastructure development eligible for $35.1 billion of federal aid over the next five years. Under this act, almost all of Alaska's Public Service airports are included, but only Bethel and Aniak are Primary Airports under the plan.

communities of Aniak, St. Mary's, Emmonak, and McGrath meet this need. Further from the central hub, flight time becomes a major item for air carriers; airports need to provide more services, including refueling capability for larger and/or faster aircraft. The towns furthest from Bethel, especially those along the Bering Sea coast, are larger and are generally more self-sufficient, although they are still related to and strongly influenced by the super hub in major ways. Freight and mail hauled to these villages may be best served in the future by direct flights from the State's super hub at Anchorage or by large aircraft from Bethel.

When considering the Y-K Delta hub model, a few contrasts with air service around hubs in the continental United States (CONUS) help develop the approach for Alaska:

- Even the towns closest to the hub are without roads and require air service. In CONUS, most of these trips would be made by automobile with the airports close to the hub being operated as a General Aviation airport with little or no scheduled service.
- In CONUS, travel to cities 50 to 100 miles from the hub, although served by small airports, is often made by automobile, bus, or train.
- When travel lengths of more than 100 to 150 miles occur in CONUS, an alternative service may be chosen. For convenience, some travelers would still drive on the ubiquitous road system to the hub.

The trade-off between automobile travel in CONUS on one hand and the lack of roads to remote communities in the Y-K Delta on the other creates the vast difference in personal air travel, as defined by enplanements per person per year and shown in the chart of Figure 3-2.

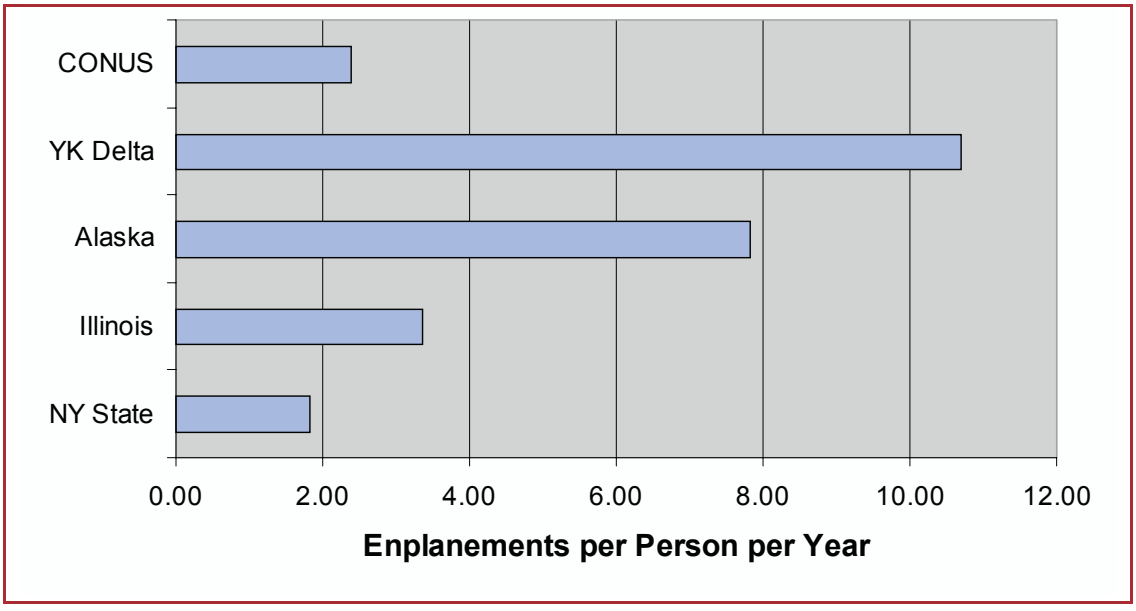


Figure 3-2 Comparison of Enplanements to Population

3.1.4 State Airport Requirements

Without roads, village residents depend on air transportation. An obvious question is "why not build roads?" The river delta formation, lack of rock and gravel for building materials, erosion, frozen soils, land nearly saturated with wetlands, and Federal land designated for wildlife habitat make it difficult and expensive to build inter-community roads. Maintaining roads in winter is also difficult and expensive. These are major reasons that airport runways are also expensive to site and construct in the Y-K Delta. Yet for the last 6 years, DOT&PF and the FAA have recognized that there is a dramatic need for airport improvement, especially for the small villages, and they are working to reconstruct and in some cases relocate the runways to meet the desired length for rural operations.

When planning started in 1998, 22 of the region's 53 airports met the State's 3,300-by 60-foot runway minimum standards. Since then, 20 more are in the process of being extended or relocated. The region's remaining runways are in design, are subject to land negotiations, or face conditions that require relocation for standards to be accommodated.

3,300-foot runways are adequate for the traffic to many of the tundra villages over the next 20 years, while 4,000- to 5,000-foot runways will be needed at many of the larger or more distant villages. This is especially true of those villages that require jet medevac service as a sub-regional health clinic site, need air delivery of fuel, receive larger aircraft cargo, or airlift fish products. Equally important, passenger demand, which will grow with the population, will require new 9–, 19–, and in some cases 30–seat aircraft. The larger aircraft, except in a few instances, require longer, wider runways. Further, the growing need for Bypass mail and airfreight capacity and improved operational safety is creating pressure for larger, more sophisticated aircraft that carry two pilots and usually need longer runways.

These demand elements are consistent with the evolution of the super-hub model.

3.2 Passenger Demand Forecast

The continued importance placed by Y-K Delta villages on subsistence living, their fast growing population, and the role of Bethel as the region's hub were major factors in shaping the passenger demand forecast.

There are two important factors to be forecast: The first is simply the change in enplanements that will grow as the population grows. The second is a trend throughout the country that on average people are flying more. It may be that, with their already high level of air travel, the residents in the Y-K Delta are reaching a limit. Figure 3-3 shows that is not the case. It depicts the history of enplanements per person for four Y-K Delta villages. They all show a general trend upward. Kipnuk, for example, was well on the way to twelve enplanements per person before poor fishing seasons in 1996 and 1997.

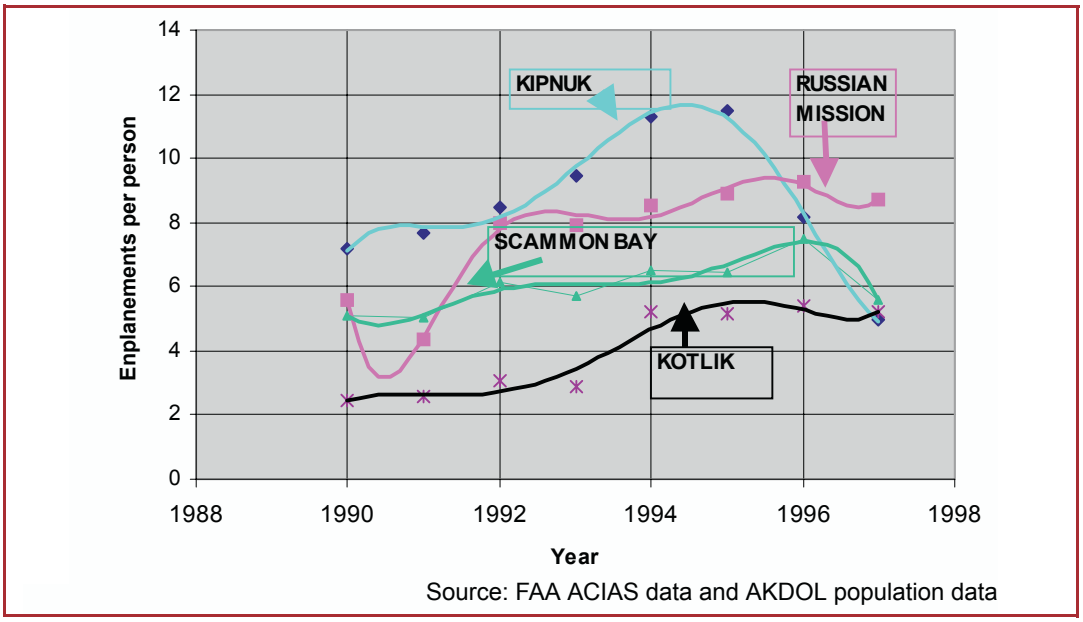


Figure 3-3 Enplanement History at Four Villages

It was noted that at almost every village, the number of enplanements per person had been growing until the poor fishing seasons of the past five years. A long-term view of the region assumes that with better fishing and other economic activity improvements, the former travel patterns will resume until some practical limit, outlined below, is reached.

The model adopts the expectation that such increased flying will not go on forever. There is a limit to time and economic capability as well as the need to do other things to maintain subsistence living. The accepted Gompertz logistic model was combined with each village's population and enplanement histories to develop an enplanement forecast which would limit the travel as necessary. The limit was set at 12 boardings or enplanements per person for villages furthest from Bethel. Travel to Bethel would consume about six of those boardings, while travel to other villages would consume the other six boardings. Ten boardings was chosen as the upper limit for those villages near to Bethel that have alternatives to air travel like snowmachines and ice roads in the winter and skiffs in the summer.

The population forecast (discussed in Section 1 and provided in Appendix A) was instrumental in developing the demand forecast both for passengers and mail. In other settings, like CONUS or Alaska urban areas, factors of economy and employment would also be used to improve the forecast. For the Y-K Delta, where subsistence harvests play a major economic role, traditional economic data was difficult to use. Adding this data did not offer any significant improvement to the forecasting accuracy.[2]

2. The coefficient of determination (R^2) for population alone was about 0.78. Adding any other variable, which might have helped explain the past changes in enplanements, never increased it beyond 0.81.

Steps to Forecasting Passenger Enplanements

The forecast used a disaggregate model in which particular "origin-to-destination" types of travel were examined for a village or small cluster of villages and forecast independently. The final forecast combines the individual forecasts obtained in the five steps indicated below.

Step 1: Determine Travel from Villages to Hubs

The FAA database provides "market" data for hub airports indicating the origin of flights to the hub. In this case, there were over ten years of data available for all existing Y-K hubs except Emmonak, which did not become a hub airport until late 1994. Table 3-1 shows that in 1996 about 55% of all trips were taken to Bethel. This level of travel has been constant over the years. This data does not include trips that went through Bethel to other places.

Step 2: Determine Resident Travel between Villages

Table 3-1 shows villages, their total enplanements, and percentage of enplanements to Bethel. Also shown is travel that was not to Bethel; a small amount of this was to the other hubs which could be "village" destinations for some travelers. The remainder is assumed to be village-to-village travel. Since we were interested in the aggregate of inter-village travel, the summation of all the non-hub travel would represent one-way trips from one village to another. Thus some of the passengers boarding would be going to another village to visit, and the others that had come from another village to visit were returning. This data was summed and used as the element to forecast travel from villages to other villages. Such travel is often for educational and business trips and trips to visit friends and relatives.

Step 3: Determine Resident Travel from Hubs to Villages

This step reflects the assumption that each trip, to/from a village or from/to a hub, was also the cause for a trip in the reverse direction. The data from Step 1 formed the basis for a portion of the enplanements at each of the hubs.

Step 4: Determine Travel between Hubs

The same market data used in Table 3-1 also presents the enplanements occurring at one hub for travel to another hub. This data was analyzed and forms the basis for another component of the enplanements at each of the hubs.

Step 5: Determine Travel to Anchorage from Hubs

Data was obtained from the FAA Air Carrier Activity Information System (ACAIS) that indicated the trips from Anchorage to each of the hubs. It was assumed that for each of these trips there would be a return trip. This then gave the fifth component, hub enplanements for return travel, which was used to complete the forecast.

Step 6: Develop Overall Forecast

These results were combined and appear in Table 3-2. Table 3-4 shows the actual numbers and forecast for each hub and Table 3-5 provides the same for each village.

Table 3-1 Travel to Bethel Enplanement Data for Selected Villages 1996

Y-K Villages	Total Enplanements	Enplanements for Bethel	% to Bethel	Enplanements to Other Villages
Akiachak	3089	1318	42.7%	1,772
Akiak	2115	927	43.8%	1,188
Alakanuk	3637	1813	49.8%	1,824
Atmautluak	2645	1262	47.7%	1,384
Chefornak	3379	2278	67.4%	1,101
Chevak	4027	3019	75.0%	1,008
Eek	1272	751	59.0%	521
Emmonak	5489	2427	44.2%	3,063
Goodnews Bay	1501	9645	64.3%	537
Hooper Bay	5264	3321	63.1%	1,943
Kalskag	4119	1597	38.8%	2,522
Kasigluk	3529	2226	63.1%	1,303
Kipnuk	4506	3386	75.1%	1,120
Kongiganak	3509	2785	79.4%	725
Kotlik	2797	1095	39.1%	1,702
Kwethluk	3007	1478	49.2%	1,529
Kwigillingok	3663	643	17.6%	3,020
Marshall	2277	1169	51.3%	1,109
Mekoryuk	1818	1567	86.2%	251
Mountain Village	4197	2011	47.9%	2,186
Napakiak	1959	1072	54.7%	887
Napaskiak	1169	544	46.5%	625
Newtok	2101	1370	65.2%	732

Source FAA T-100 Market Data and ACAIS Data for 1996

Table 3-1 Travel to Bethel Enplanement Data for Selected Villages 1996 (continued)

Y-K Villages	Total Enplanements	Enplanements for Bethel	% to Bethel	Enplanements to Other Villages
Nightmute	1808	1274	70.5%	534
Nunam Iqua	1314	517	39.3%	797
Nunapitchuk	2579	1857	72.0%	723
Pilot Station	3741	1937	51.8%	1,804
Platinum	521	372	71.3%	150
Quinhagak	1136	643	56.6%	493
Russian Mission	2626	1054	40.1%	1,572
Scammon Bay	3163	1952	61.7%	1,211
St. Mary's	8401	2216	26.4%	6,185
Toksook Bay	5013	3278	65.4%	1,736
Tuluksak	2670	1786	66.9%	884
Tuntutuliak	3450	2561	74.2%	890
Tununak	2363	1739	73.6%	624
Total	**109,854**	**60,204**	**54.8%**	**49,650**
Source FAA T-100 Market Data and ACAIS Data for 1996				

Table 3-2 Demand Forecast of Enplanements for the Y-K Delta—Summary

Enplanements	1995	2000	2005	2010	2015	2020
At all non-hub village airports for non-hub travel	46.1	38.4	49.2	60.2	73.6	87.9
At all of non-hub village airports for Bethel travel	58	56.4	72.3	89.3	108.1	129.2
At all of non-hub village airports for travel to hubs other than Bethel	9.9	7.2	9.2	11.5	13.8	16.5
At Bethel airport[a]	115.5	125.9	159.5	187	215	242.6
At Aniak airport [b]	13.5	17.2	21	23.3	25.8	28.5
At St. Mary's airport	9.7	7.1	7.7	8.3	9	9.7
At McGrath airport	6.7	5.5	5.6	6	6.4	6.8
At Emmonak airport	4.5	6	6.2	6.9	7.6	8.3
Total	263.9	263.7	330.7	392.5	459.3	529.5

a At Bethel includes enplanements for travel to Anchorage, the villages, and the other hubs
b At Aniak, McGrath, St. Mary's, and Emmonak includes Anchorage, the villages each serve, Bethel, and the other hubs.

Table 3-3 Hub Enplanement Forecast

	Actual							Forecast			
	1990	1995	1996	1997	1998	1999	2000	2005	2010	2015	2020
Bethel	99,185	115,522	121,552	108,616	114,616	123,068	125,885	159,500	187,000	215,000	242,600
Aniak	10,845	13,462	14,191	15,049	17,026	16,471	17,194	21,000	23,300	25,800	28,500
St. Mary	12,785	9,732	8,401	8,499	7,590	8,281	7,126	7,700	8,300	9,000	9,700
Emmonak	1,653	4,547	5,489	5,287	5,410	6,780	5,981	6,200	6,900	7,600	8,300
McGrath	6,542	6,735	6,534	6,285	5,204	4,950	5,487	5,600	6,000	6,400	6,800
Hub Total	131,010	149,998	156,167	143,736	149,846	159,550	161,673	200,000	231,500	263,800	295,900
Village Total[a]	69,971	103,950	100,556	87,859	87,550	98,645	101,983	130,712	160,980	195,470	233,600
Y-K Delta Total	200,981	253,948	256,723	231,595	237,396	258,195	263,656	330,712	392,480	459,270	529,500
Average Annual Increase		4.8%	1.1%	-9.8%	2.5%	8.8%	2.1%	4.6%	3.5%	3.2%	2.9%

a See Table 3-4 for the individual village estimates.

Table 3-4 Village-by-Village Forecast

	Actual							Forecast			
	1990	1995	1996	1997	1998	1999	2000	2005	2010	2015	2020
Akiachak	1,080	3,037	3,089	2,107	2,107	2,412	2,681	3,340	4,400	5,400	6,500
Akiak	991	1,968	2,115	1,322	1,390	1,373	1,910	2,700	3,450	4,100	4,800
Alakanuk	1,070	3,631	3,637	3,336	4,025	3,735	4,054	5,405	6,680	8,200	10,000
Anvik	675	837	927	890	916	649	748	1,000	1,200	1,400	1,600
Atmautluak	1,436	1,944	2,668	1,820	2,042	2,065	2,355	2,865	3,500	4,200	4,900
Chefornak	1,816	2,733	3,409	2,158	2,292	3,049	3,022	3,540	4,100	4,600	5,300
Chevak	3,417	3,802	4,074	3,563	3,879	4,404	4,141	5,360	6,500	7,900	9,500
Chuathbaluk	557	265	486	307	393	236	656	500	600	700	800
Crooked Crk	0	738	947	755	1,551	720	681	1,200	1,400	1,700	2,000
Eek	3,054	1,576	1,283	1,117	1,473	1,408	914	1,710	1,900	2,100	2,400
Flat	43	24	29	6	10	29	10	10	10	10	0.0%
Goodnews	2,366	1,458	1,514	1,890	1,498	1,596	1,119	2,000	2,400	2,750	3,200

Table 3-4 Village-by-Village Forecast (continued)

	Actual							Forecast			
	1990	1995	1996	1997	1998	1999	2000	2005	2010	2015	2020
Grayling	984	1,276	1,272	964	991	1,095	1,034	1,350	1,600	1,900	2,300
Holy Cross	2,458	1,993	0	1,702	1,750	1,510	1,794	2,400	2,900	3,300	3,800
Hooper Bay	3,418	4,828	5,325	4,207	4,732	5,319	5,104	6,730	8,600	11,100	13,400
Kalskag	3,523	3,574	4,155	3,745	3,395	4,549	4,146	4,850	5,750	6,800	8,000
Kasigluk	1,608	3,554	3,560	2,613	2,121	2,439	2,805	4,110	5,200	6,400	7,500
Kipnuk	3,376	6,253	4,546	2,865	3,420	4677	4555	5,300	6,100	7,000	8,000
Kongiganak	1,941	3,312	3,540	2,446	2,514	3,349	3,041	3,600	4,300	5,100	6,000
Kotlik	1,140	2,814	2,830	2,890	3,009	3,200	3,511	4,620	5,700	7,000	8,500
Kwethluk	2,107	2,769	3,033	2,300	1,904	2,300	2,971	4,010	5,100	6,000	7,200
Kwigillingok	1,987	3,616	3,695	2,585	2,581	3,047	3,209	3,750	4,300	5,100	6,200
Lime Village	152	221	163	659	198	96	79	250	300	350	400
Marshall	1,042	2,238	2,304	2,458	2,192	2,400	2,711	3,480	4,500	5,700	7,000
Mekoryuk	1,735	1,660	1,834	1,687	1,897	1,954	1,887	2,290	2,600	3,000	3,600
Mt. Village	1,748	4,772	199	4,901	4,657	5,523	5,448	6,980	8,700	10,300	13,000
Napakiak	0	1,625	1,976	1,263	1,326	1,233	1,125	1,700	2,200	2,800	3,600
Napaskiak	657	875	1,179	831	656	748	1,754	1,400	1,600	1,900	2,300
Newtok	1,429	2,178	2,119	1,577	1,419	1,500	1,754	2,320	2,830	3,300	3,800
Nightmute	1,009	1,644	1,824	1,278	1,348	1,537	1,311	2,000	2,600	3,400	4,300
Nikolai	424	967	761	580	321	356	540	600	700	800	1000
Nunam Iqua	268	1,213	1,329	1,204	1,105	1,370	1,843	2,000	2,470	2,900	3,500
Nunapitchuk	1,359	2,400	2,602	2,166	1,954	2,502	2,772	3,860	4,700	5,550	6,500
Pilot Station	1,437	3,559	3,785	3,284	3,553	4,703	3,903	5,260	6,900	8,800	10,000
Platinum	948	652	526	492	415	510	448	520	630	700	800
Quinhagak	4,062	1,414	1,146	1,530	1,780	1,666	2,362	2,800	3,700	4,900	6,000
Red Devil	488	509	503	397	255	250	288	450	600	700	800
Russian Mission	1,373	2,633	2,657	2,635	1,983	2,470	2,519	3,020	3,900	5,100	6,500
Scammon Bay	1,742	2,820	3,200	2,615	2,638	2,864	3,022	3,780	4,950	6,300	7,500
Shageluk	1,106	1,294	1,006	984	1,076	788	1,112	1,450	1,820	2,100	2,500
Sleetmute	630	699	828	772	617	671	590	790	1,000	1,200	1,400

Table 3-4 Village-by-Village Forecast (continued)

	Actual							Forecast			
	1990	1995	1996	1997	1998	1999	2000	2005	2010	2015	2020
Stony River	576	491	344	290	286	347	334	450	550	700	800
Takotna	362	606	481	891	163	129	65	472	520	600	680
Telida	0	86	44	2	1	5	12	10	10	10	10
Toksook Bay	3,181	4,083	5,057	3,144	3,322	3,938	3,516	4,750	5,600	7,300	8,500
Tuluksak	1,073	2,994	2,693	2,410	2,390	2,775	3,072	3,670	4,700	5,900	7,200
Tuntutuliak	2,245	3,797	3,480	2,586	2,371	3,342	3,401	4,010	4,560	5,200	6,000
Tununak	1,878	2,542	2,384	1,613	1,637	1,826	1,635	2,050	2,650	3,200	4,000
Village Total	69,971	103,950	100,553	87,860	87,549	98,645	101,983	130,712	160,980	195,470	233,600

3.2.1 Checking the Passenger Demand Forecast

The reasonableness of the forecast was checked in two ways.

Does it fit reasonably with a trend line for the region?

Figure 3-5 shows how the trend line developed from past history is not violated. It closely follows either a linear or the constant rate of growth about 3.4% per year that one would predict. The straight-line fit of the curve is also shown for reference with a Coefficient of Determination greater than 95%.

Does it represent an elasticity of demand that is reasonable?

For Y-K Delta village residents this is probably between one and three.[3] Figure 3-4 shows the elasticity of demand relative to population. As the population grows, one would expect the enplanements to grow as well. As is usually the case with commercial aviation, as the Y-K Delta communities have grown, the percent change in enplanements has grown more. An average line through the data would indicate an elasticity of about 3, while at its peak it was higher at 5. The planning team adopted the conservative approach in the range of 1.5 to 2. An average annual growth in population from 1995 to 2020 is 1.92% with a resulting average annual enplanement growth of 3.28% and a demand elasticity of 1.7.

3. Elasticity is the ratio of the percent change in one variable (enplanements) to the percent change in another major variable (population).

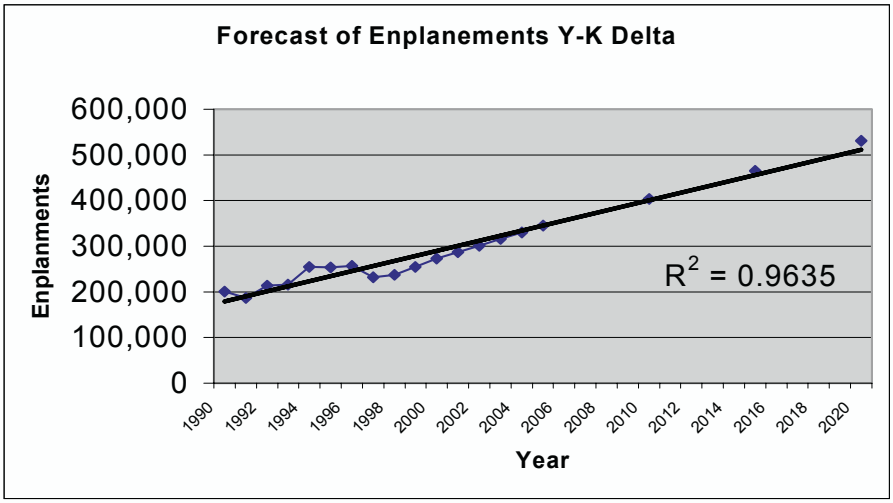
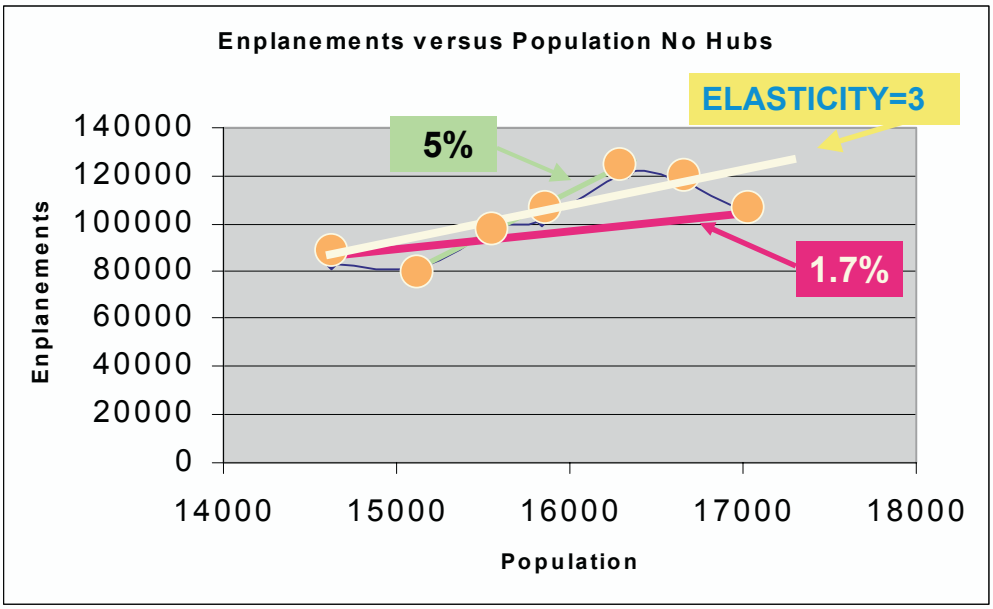


Figure 3-4 Forecast Related to Past Data for Enplanements in the Y-K Delta



Note: The above elasticity does not include the hub enplanements as they would skew the data.

Figure 3-5 Measure of Elasticity of Demand (1990 to 1997)

3.3 Mail Forecast

The air transportation system not only moves people throughout the region but it also serves as the equivalent of the "wholesale-to-retail" distribution system for groceries and other consumer goods in the region. In other parts of the country trucks and other surface transportation modes dominate.

Since the level of goods shipped into the Y-K Delta region results in about the same number of flights as the demand for passenger travel, the impact on aviation is significant, and must be factored into the planning.

The mail moves under a special provision in the law that permits air delivery of fourth-class mail to bush Alaska. Rates are about 20-40% of private air cargo rates. At one time, stores received some goods by airfreight but most arrived on barge. Today the stores in the Y-K Delta depend almost entirely on the fourth-class mail system. Items not permitted through the mail, such as bleaches, still arrive by air cargo.

3.3.1 Present Mail System

Mail delivery as a part of retail distribution continues to grow throughout Alaska. Mainline routes that move goods from shippers in Anchorage and Fairbanks to the designated regional hubs around the state has grown from 90.5 million pounds in 1986 to 120 million in 1997. The volume to non-hub villages has grown from 36.4 million pounds in 1986 to 60 million pounds in 1997.

The Y-K Delta is the system's heaviest regional user, receiving about 40% of the state's fourth-class mail. The demand for mail delivery, particularly fourth-class mail, is expected to continue to grow in the bush as populations grow and villages transition to a stronger, more diverse cash economy.

Heavy goods, including construction materials and large, heavy consumer items (e.g., snow machines), and hazardous goods come by barge as common freight in the summer and/or by regular air cargo service throughout the year. About 75% of the mail that goes to the villages travels through the Bypass mail system. The remainder, usually personal orders, goes through the normal USPS system as regular mail both non-priority and priority.

Bypass Mail

USPS developed the Bypass Mail Program to handle Alaska's large fourth-class mail volume. Products go directly from a wholesale warehouse to shippers, and then to air carriers who deliver the orders to village stores and other large order customers. Products are shrink-wrapped onto pallets. These pallets do not go to the Post Office in Anchorage or Fairbanks, the Post Office in the regional hub, or the Post Office in the destination village. A postal inspector meets a shipper at the designated air carrier to transfer orders directly to the air carrier. From there, it is the air carrier's responsibility to have the mail delivered to the recipient in the village. The process is outlined below.

- A village store and other large volume purchasers place an order with a wholesale warehouse. Orders must exceed 1,000 pounds

to be eligible for Bypass mail. Most orders are several thousand pounds - the average is about 3,500 pounds.

- The order is prepared for transport by one of several certified shippers.
- A shipper subdivides an order into packages that meet fourth-class mail weight and size requirements, applies postage, and places several packages on pallets, which cannot exceed six feet in height. Each pallet is shrink-wrapped into a secure unit.
- The order is taken to designated mainline air carriers where a postal inspector weighs, inspects, and transfers the order from shipper to air carrier.
- The order is flown to one of the regional mail hubs, where the order is transferred to bush air carriers based on USPS "equal tender" guidelines. If the order is for a store at the hub, the mainline air carrier agent delivers the order to the store.
- Bush carriers break down the pallets to load it into their small aircraft. Bypass mail is then flown on scheduled flights to the specified village.
- At a village, bush air carriers deliver their portions of the order directly to the store.
- Separate pallets are made for each order and within an order for each commodity. Bypass mail orders by stores tend to average about 70% dry goods, 15% perishable goods, and 15% frozen product. Mainline air carriers must provide proper storage. It is expected that bush air carriers will get orders to stores within the 36-hour guidelines and freeze/chill storage is not required of these carriers. Air carriers are not responsible for damage. The store absorbs the cost of damaged goods, although a report can be filed with USPS for their records.

The USPS service standard for Bypass mail, as non-priority, fourth-class mail, is the 5–10 days service standard for non-priority mail throughout the country. For Bypass mail, however, USPS has what is known as the "36/36-hour rule." This rule is actually a 'planning window,' not a standard. The window requires mainline carriers to move mail to regional hubs by the end of the day following the day it was received. Bush carriers at the regional hubs have the same requirement: deliver to the destination by the end of the day following the day an order was received. This can be more or less than 36 hours, depending upon receipt time of day. If the mainline or bush carriers do not move mail within the 'planning window,' USPS inspectors evaluate whether to transfer mail or keep it with the carrier that has it. Bad weather, air carrier operational decisions, USPS transfers amongst carriers, and aircraft transfers can result in delivery delays of up to 10 days, causing substantial damage to perishable products at the bush carrier level because fresh/frozen storage capability is not currently required.

Before Bypass mail, village stores placed orders to shippers in Anchorage. Shippers prepared the orders according to regular USPS postal regulations and took them to the post office for shipment or to an air carrier for shipment by air cargo, and in some cases by summer barge. There is no difference in the cost sending goods at Bypass mail rates. However, by having packaging, stamping, and palletizing capabilities in-house, shippers benefit by processing orders faster, and USPS workload and space requirements are significantly reduced.

The popularity of delivering goods through USPS grew rapidly after the introduction of Bypass mail in the mid-1980s. The ease of ordering, the considerably lower cost compared to air freight rates, the quick shipment coupled with lowered inventory costs at the store, and ease of working with individual shippers contributed to the rapid increase in Bypass mail volumes.

Figure 3-6 Anchorage Cold Storage Preparing a Bypass Mail Order (DOT&PF)

Figure 3-7 Village Delivery Bypass Mail at the Emmonak Hub (DOT&PF)

Mail Volumes

In 1999, Y-K Delta postal hubs received about 47 million pounds of fourth-class mail. About 25 million pounds – a little over half the total weight – is redistributed from hubs to smaller villages by certified carriers, on about 70,000 small aircraft flights each year.

As an example, Hooper Bay (population 1,028) received just less than 2 million pounds of fourth-class mail in 1999. If the mail is flown from the Bethel hub on aircraft with a payload of 800 to 1,200 pounds, about 2,000 flights a year, an average of 8 flights a day, 5 days a week all year are required. The orders come out of Anchorage in 15,000- to 30,000-pound loads, so meeting the 36-hour delivery time means as many as 15 small aircraft flights on some days. It seems clear that eventually larger villages will see deliveries by larger aircraft. Those aircraft will likely require longer runways.

Table 3-5 shows the breakdown of mail between the mainline, which enters at the hub and the bush routes that leave the hub for the villages. Table 3-6 gives a summary of the per person consumption of mail by the villages, the smaller hubs, and Bethel. The higher per capita consumption at the hubs and Bethel is probably indicative of the role the hubs play in resale, health care, local conferences, and more visitors.

The increasing volumes of fourth-class mail and the need for larger aircraft to accommodate that increase are critical considerations to decision-making about airport improvements in the region.

Table 3-5 Y-K Delta Mail Delivery in 1997

Y-K Delta HUB	Pounds of Mail in 1997		Villages Served
	Into Hub from Anchorage	Out to Villages from the Hub	
Bethel	31,994,300	15,142,200	26
Aniak	4,809,600	3,744,800	11
Emmonak	3,870,300	2,353,800	3
St. Mary's	3,514,200	1,959,400	3
McGrath	1,571,900	310,800	5
Total	**45,760,300**	**23,511,000**	**48**
	37% of Alaska	**41% of Alaska**	

Source: USPS Data Reports, 1997

Table 3-6 Per Capita Consumption of Goods Delivered by USPS in 1997

Recipients	Goods Delivered by USPS	Population	Per Person Consumption
Y-K Delta Region	45,760,300 lbs.	24,848	1,842
Bush Villages	23,511,000 lbs.	17,059	1,378
Bethel	16,852,100 lbs.	5,277	3,194
Hubs other than Bethel	5,397,200 lbs.	2,512	2,149

Source: USPS Data, 1995,1996, 1997, 1998, and 1999, Alaska Parcel Post Task Force report, BEA Data on Alaska Economy

3.3.2 Forecasting Methodology

This summary presents the Bypass mail forecast for the Y-K Delta. Details about the forecast are presented in Appendix D. To forecast demand, four sets of parcel post data were evaluated.

1. Statewide Parcel Post Demand
2. Y-K Delta Parcel Post Demand
3. Aggregate Demand by Village Type:
   - Bethel
   - Other Hubs
   - Large Villages (population >650 persons)
   - Typical Villages (125 to 650 persons)
   - Small Villages (< 125 persons)
4. Overall Trend Data

In developing the forecast, future estimates of (1) actual consumption rates in pounds per person (lb/capita or *lpc*) and (2) the annual growth in the consumption rate in pounds per person per year (*lpcpy*) were generated. Since each of the methods had some difficulty, regression analysis using "P" test evaluation was used throughout.

Social factors including average income, persons per household, employment, enplanements, and number of government jobs were used in standard regression analyses. Sometimes the tests for significance were positive; other times they were not. The analysis techniques applied conservatism, since only five years of data at the village level was available. The results of the different analyses were blended and adjusted slightly to meet the actual present demand.

Data used in this analysis covers the parcel post demand in both its infancy and as the system has matured. Long-term patterns may not be reliably forecast because weight per capita may rise and fall in cycles, or may continually increase without apparent upper limit. However, present and recent consumption patterns are a useful starting point. The methods used are also based on the general belief that mail per capita will generally increase over time as economic activity and quality of life improves in Y-K Delta villages.

Steps to Forecast Demand for Parcel Post in the Y-K Delta

Step 1: Forecast Demand for Parcel Post Statewide

The source of the statewide data is the overall USPS data for the State of Alaska. These data are combined with population data from census areas where the Bypass mail system is supplying villages. These data are then combined with available Bureau of Economic Analysis (BEA) data and forecasts on employment, income, and the like. Adjustments were made for the relationship between urban and rural (non-metropolitan) populations resulting in the statewide values of pounds per dollar incomes and the growth in pounds per capita shown in Table 3-7.

Table 3-7 Statewide USPS Mail Demand Forecast

Year	Pounds/ Dollar Income	Pounds/ Capita (non metro) (lpc)	Pounds/ Capita/Year (lpcyp) Growth
2000	.0619	1,047	19.2
2005	.0651	1,154	21.5
2010	.0683	1,270	23.1
2015	.0713	1,381	22.3
2020	.0735	(BEA forecast unavailable)	
2025	.0759	1,587	20.6

Note that the annual increase in weight per capita is proposed to be higher (around 20 to 23 lb) than historic weight per capita growth (14.1 lb). Further, the annual increase grows during the first half of the forecast period, peaks around year 2010, and declines later. However, the weight per capita and weight per average dollar of income continue to increase over time.

Step 1b: Use Statewide Forecast as Basis of Y-K Delta Region Demand

The weight per capita for the Y-K Delta has been increasing at 23.7 pounds annually according to a best-fit linear regression. However, the P value is 0.216, so that it is reasonable to suggest that the actual regional growth is not so high. Table 3-8 compares the 95% confidence interval of the Y-K Delta weight per capita growth over the years to the statewide analysis.

Table 3-8 Growth Levels with 95% Confidence

Pounds/Capita/Year (lpcpy) Growth			
	Best Fit	Lower 95%	Upper 95%
Statewide	14.1	8.1	20.1
Y-K Delta	23.7	-24.6	71.9

It cannot be said with certainty that Y-K Delta historic growth has a higher rate than the historic statewide growth. To be conservative, the model assumes annual growth of mail in the Y-K Delta behaves somewhat like the statewide growth. The model uses the proposed future annual growth of weight per capita from the statewide forecast and applies it to the Y-K Delta.

The starting point for projected Y-K Delta weight per capita for the year 1999 is proposed to be the value of the best fit single variable linear regression model, 1,996 lpc, instead of the actual weight per capita, 2,002 lpc. Applying the increases gives us the regional weight per capita.

Multiplying this weight per capita by the population forecast used in the passenger forecast gives us the total weight of mail to be delivered to the region as shown in Table 3-9.

Table 3-9 Y-K Delta Total Forecast

Y-K Delta Forecast		
	lpc*	Estimate of Total Weight to Y-K Delta (lbs)
2000	2,015	52,440,000
2005	2,118	61,530,000
2010	2,230	72,390,000
2015	2,344	84,790,000
2020	2,452	99,000,000
		*lpc = lbs per capita

Step 2: Forecast Growth of Each Group of Y-K Delta Villages

The second step is to forecast the growth of individual villages based on village groupings. It is assumed that all villages, regardless of which group they belong to, will increase their weight per capita over time. A general assumption is that if a village shows consistent weight per capita growth over the five-year period from 1995 to 1999 it will be higher for the 25-year forecast period than a village that over the five-year period shows weak or negative growth.

There is also an assumption of weight per capita ranges (from Table 3-9). A single variable linear regression performed for each village group combined with the property of consistent growth of individual villages was used to arrive at weight per capita. Bethel was initially proposed to have minimal growth (7 lpcpy), but was later selected to accept the Y-K Delta 'residual weight' not claimed by the other four groups indicated below. These trial weights are used in the first village-by-village forecast. Step 3 adjusts the group forecasts so that the region-wide forecast will be maintained. Once the villages were examined, they were sorted into five groups.

1. Bethel
2. Other Hubs
3. Large Villages (population >650)
4. Typical Villages (125 to 650)
5. Small Villages (< 125)

Table 3-10 shows that while the annual weight growth for the entire region is forecast to be 20 to 23 pounds per capita over the next 25 years, group averages are lower or higher.

Table 3-10 Final Range of Annual Growth Rates (Adjusted)

Range of Annual Weight Growth	
Y-K Delta	20 to 23 lpcpy*
Bethel Hub	0 to 20 lpcpy
Other Hubs	5 to 9 lpcpy
Large Villages	30 to 50 lpcpy
Typical Villages	25 to 30 lpcpy
Small Villages	17 to 19 lpcpy
	*lpcpy = lbs per capita per year

Step 3: Adjustment

The third step is to adjust initial individual village forecasts so that the weights delivered to individual villages is equal to the Y-K Delta forecast given in Table 3-9.

3.3.3 The Forecast

Table 3-9 shows the forecast for annual mail for the overall Y-K Delta. The forecast for weight consumed per person is shown in the left part of Table 3-11; the annual weight consumed by village is in the right portion of the table.

Table 3-11 Estimated Future Demand for USPS Non-Priority and Bypass Mail

	Pounds per Capita				Pounds per Village (nearest 100 pounds)			
Village	2005	2010	2015	2020	2005	2010	2015	2020
Akiachak	1,550	1,678	1,822	1,972	961,900	1,158,300	1,395,200	1,676,300
Akiak	1,400	1,542	1,699	1,860	547,800	671,300	820,400	997,300
Alakanuk	1,800	1,970	2,160	2,352	1,476,300	1,866,400	2,359,100	2,957,600
Anvik	2,700	2,774	2,864	2,968	254,300	278,200	303,700	332,700
Atmautluak	1,400	1,542	1,699	1,860	503,600	617,100	754,200	916,800
Chefornak	1,750	1,928	2,124	2,321	744,800	912,700	1,115,600	1,353,600
Chevak	2,300	2,472	2,714	2,990	2,085,500	2,589,100	3,277,300	4,158,000
Chuathbaluk	1,800	1,986	2,174	2,363	244,700	300,300	364,600	440,000
Crooked Creek	1,850	1,918	2,001	2,092	274,300	316,400	366,100	425,000
Eek	1,600	1,801	2,017	2,231	579,900	726,100	902,100	1,107,700
Flat	3,000	3,002	3,006	3,011	30,000	30,000	30,100	30,100
Goodnews Bay	1,950	2,012	2,089	2,174	621,100	712,800	820,900	948,600
Grayling	2,050	2,105	2,176	2,255	537,100	587,300	641,800	703,300
Holy Cross	1,950	2,040	2,150	2,268	654,500	729,100	812,300	906,100
Hooper Bay	2,300	2,472	2,714	2,990	2,955,300	3,669,000	4,644,300	5,892,300
Kalskag	1,600	1,684	1,783	1,887	992,900	1,162,700	1,364,900	1,604,700
Kasigluk	1,600	1,723	1,863	2,009	966,600	1,158,000	1,388,700	1,662,500
Kipnuk	1,650	1,768	1,904	2,046	1,046,600	1,247,800	1,490,200	1,777,800
Kongiganak	1,450	1,587	1,740	1,897	623,100	758,800	922,700	1,117,100
Kotlik	2,150	2,266	2,410	2,563	1,508,600	1,836,700	2,252,200	2,758,000
Kwethluk	1,450	1,587	1,740	1,897	1,130,800	1,377,100	1,674,400	2,027,200
Kwigillingok	1,650	1,843	2,053	2,261	584,500	726,300	897,200	1,097,200
Lime Village	800	815	830	847	51,600	58,500	66,100	74,900
Marshall	2,250	2,312	2,396	2,491	967,100	1,147,700	1,371,300	1,641,800
Mekoryuk	2,150	2,266	2,410	2,563	495,900	581,400	685,900	810,000

Table 3-11 Estimated Future Demand for USPS Non-Priority and Bypass Mail (continued)

	Pounds per Capita				Pounds per Village (nearest 100 pounds)			
Village	2005	2010	2015	2020	2005	2010	2015	2020
Mountain Village	1,750	1,892	2,071	2,274	1,876,500	2,343,400	2,957,700	3,739,100
Napakiak	1,500	1,591	1,695	1,806	687,900	811,500	959,100	1,134,400
Napaskiak	1,250	1,357	1,476	1,601	559,500	675,600	815,400	981,800
Newtok	1,650	1,768	1,904	2,046	491,600	586,100	700,000	835,000
Nightmute	1,700	1,814	1,945	2,083	406,100	482,000	573,300	681,700
Nikolai	1,400	1,415	1,430	1,448	191,000	205,500	219,700	235,100
Nunam Iqua	1,950	2,097	2,267	2,442	331,700	412,000	513,600	637,100
Nunapitchuk	1,500	1,633	1,781	1,934	792,900	960,000	1,161,700	1,400,900
Pilot Station	1,650	1,843	2,053	2,261	1,170,300	1,510,100	1,938,900	2,459,100
Platinum	2,100	2,249	2,404	2,565	193,200	230,100	272,900	323,200
Quinhagak	1,650	1,731	1,826	1,928	1,153,100	1,345,700	1,574,800	1,846,200
Red Devil	2,700	2,705	2,711	2,718	200,200	223,100	248,000	276,100
Russian Mission	2,050	2,105	2,176	2,255	747,300	886,400	1,056,300	1,260,700
Scammon Bay	1,700	1,814	1,945	2,083	893,400	1,101,000	1,361,200	1,678,500
Shageluk	2,050	2,105	2,176	2,255	334,100	365,400	399,300	437,500
Sleetmute	2,100	2,249	2,404	2,565	331,600	395,000	468,300	554,800
Stony River	2,600	2,605	2,612	2,621	174,900	195,000	216,800	241,500
Takotna	2,500	2,506	2,514	2,523	108,700	116,000	123,000	130,500
Telida	2,000	2,010	2,021	2,034	20,000	20,100	20,200	20,300
Toksook Bay	1,750	1,859	1,986	2,120	973,100	1,149,900	1,362,600	1,615,000
Tuluksak	1,550	1,759	1,981	2,200	751,200	948,100	1,184,800	1,461,100
Tuntutuliak	1,650	1,843	2,053	2,261	679,600	844,500	1,043,200	1,275,800
Tununak	1,550	1,678	1,822	1,972	638,400	768,800	926,000	1,112,600
Bethel	2,998	3,114	3,158	3,138	19,407,100	21,952,500	24,137,300	26,048,600
Aniak	2,698	2,765	2,835	2,906	1,959,700	2,234,100	254,100	2,891,700
Saint Mary's	2,321	2,291	2,260	2,234	2,013,000	2,294,900	2,610,200	2,970,500
Emmonak	2,123	2,096	2,068	2,043	1,967,300	2,242,700	2,550,900	2,902,900
McGrath	2,664	2,852	3,068	3,303	1,685,200	1,921,100	2,185,100	2,486,600

Table 3-11 Estimated Future Demand for USPS Non-Priority and Bypass Mail (continued)

	Pounds per Capita				Pounds per Village (nearest 100 pounds)			
Village	**2005**	**2010**	**2015**	**2020**	**2005**	**2010**	**2015**	**2020**
Total					61,577,400	72,439,700	82,555,700	99,054,900
Bush					34,545,100	41,794,400	50,818,100	61,754,600
Hub					27,032,300	30,645,300	31,737,600	37,300,300

This forecast of future mail demand is plotted on Figure 3-8. The upper curve is the forecast presented, while the lowest curve is a simple linear trend forecast. The middle curve is an exponential trend forecast. The average annual growth in the detailed forecast is 3.45% per year. This is reasonable, considering the high average population growth, the nature of the Bypass mail system, and the potential for steady economic growth in the villages.

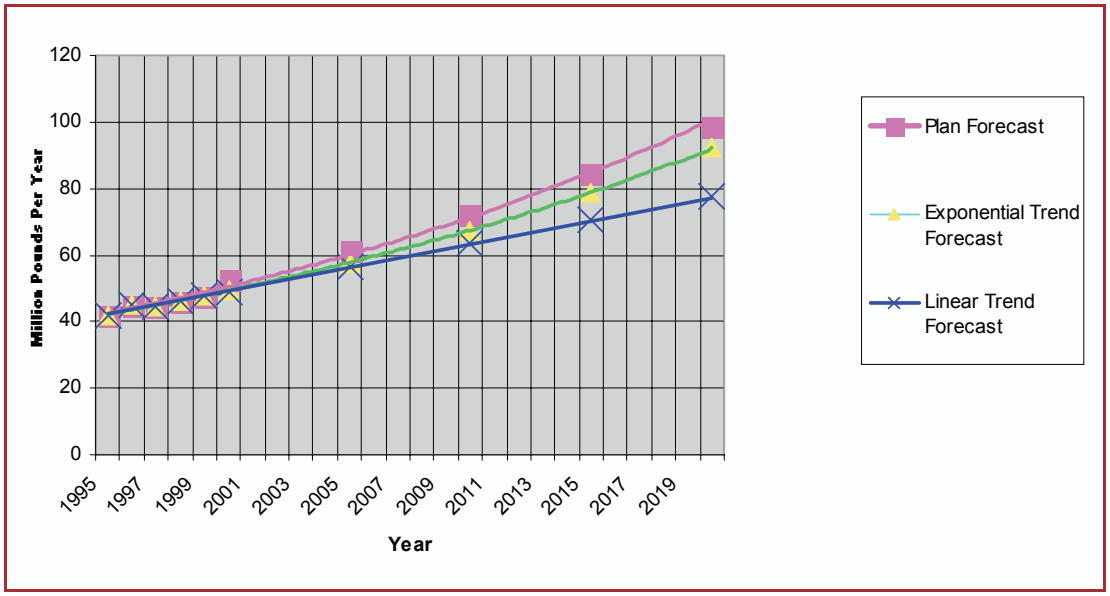


Figure 3-8 Estimated Future Demand for USPS Non-Priority and Bypass Mail

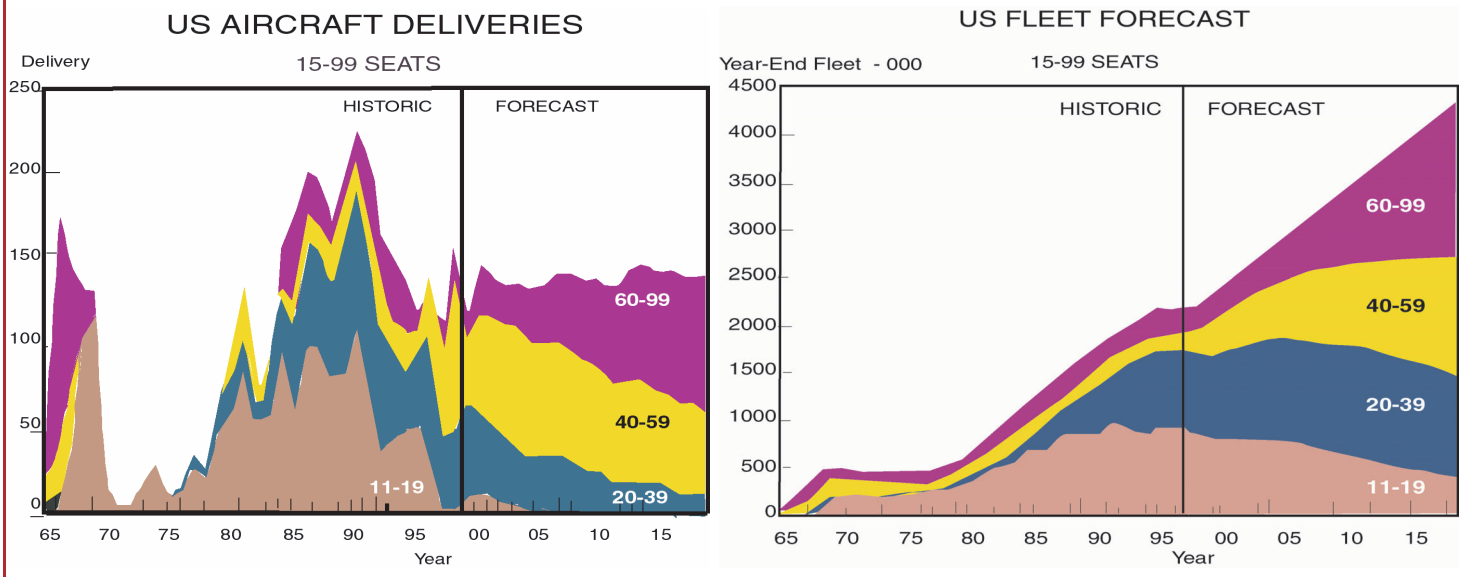
3.4 Aircraft Fleet Evolution

This section examines the supply side of air operations in the Y-K Delta.

- What aircraft will air carriers purchase next to upgrade service to the Y-K Delta?
- What runway dimensions do the aircraft require?
- When will the new aircraft move into Y-K Delta markets?

3.4.1 The Next Aircraft

The likely scenario for future aircraft that serve rural Alaska are those aircraft that will move from the fast growing commuter markets in the Lower 48 (CONUS) to Alaska as used aircraft. This is consistent with past fleet evolution trends in Alaska. Aircraft Deliveries in Figure 3-9 shows how the orders for aircraft in the CONUS commuter market are increasing from 19-seat passenger to 30-seat passenger aircraft. The U.S. Fleet Forecast indicates how the fleet is expected to change in the next 20 years. Since active aircraft in CONUS tend to become Alaska's next commuter/mail aircraft, it is reasonable to examine the aircraft presently in use. Table 3-12 shows the present (1998) use of commuter aircraft in the United States commuter market with those reported in Alaska service indicated.



Source: Regional Airline Association 1999 Annual Report

The Regional Airline Association data show that the U.S. market is shifting to larger, faster commuter aircraft. Requests for new, 19-seat aircraft have greatly diminished, while orders for 30- to 60-seat jet aircraft are increasing. The fleet serving the Y-K Delta is largely composed of small 5- to 6-passenger aircraft, a few 9-passenger aircraft (Cessna 208 and Piper Navajo), and 19-passenger DeHavilland twin otter aircraft. As the need for payload increases, it is expected that the Piper Navajo and Cessna 208 will be used more extensively, and longer term, the 19-seat Raytheon 1900D will find extensive use.

Figure 3-9 Prediction of the Changing Commuter Aircraft in the Continental United States

Table 3-12 Use of Commuter Aircraft in the United States

Manufacturer	Aircraft	Number in Regional Airline Service	Number in Alaska Air Carrier Service (1998)
30-Seat Aircraft			
Scania	SAAB 340A	247	2
Embraer	120	179	0
Bombardier/deHavilland	Dash8Q	175	2
Fairchild	Donier 328	48	0
CASA	212-300	165	4
Total		664	8
19-Seat Aircraft			
Raytheon	Beech 1900	194	20
British Aerospace	31/32/41	105	0
Fairchild	Metro/23	23	7
Total		322	27
9-Seat Aircraft			
Piper	31 Navajo	58	50
Bombardier/DeHavilland	6 Twin Otter	36	16
Cessna	208 Caravan	11	29
Raytheon	Beech 99	13	4
Total		141	99
5- to 7-Seat Aircraft			
Cessna	207/206	100	93
Piper	32 and others	85	76
Cessna	402	82	4
Other Cessna	(e.g., 185, 172)	37	30
Total		**336**	**203**

Source: Regional Airline Association 2001 Annual Report

3.4.2 Aircraft Impact on Runway Dimensions

The FAA establishes airport dimensions based on aircraft using the runway and the runway's VFR or Instrument Flight Rule (IFR) landing procedures in *Airport Design Advisory Circular* (AC) 150/5300-13. Each aircraft has a minimum runway length for operation, usually for take-off with a full load. Each aircraft is also given an Airport Reference Code (ARC) designation based on its wingspan and approach speed (Table 3-13). For the Y-K Delta, non-precision instrument landing capability has to be included for the FAA Capstone Program.

3.4.3 Which Aircraft should be used for Airport Planning?

A "design aircraft" should be selected for each village airport based on forecast of enplanements and/or mail/freight volume. It should not be extreme in its seating category, but instead needs to be a representative mixture of speed, seating, comfort, safety, and availability. After looking at the history of fleet evolution in Alaska, the trends in aircraft purchases nationwide, and after multiple discussions with airlines, passengers, and air-dependent businesses, it was decided that the aircraft in Table 3-14 should be the design aircraft for each class of seating and cargo capacity.

Table 3-13 Requirements of Various Aircraft for Critical Airport Dimensions

Aircraft Type	ARC	Runway Width (feet)	Runway Length (feet)	Safety Area Past Runway End (feet)	Passenger
Cessna 206	A-I	60/75*	1,500	240/600*	5
Cessna 207	A-I	60/75	1,800	240/600	6
Cessna 208 (Caravan)	A-II	75/100	2,050	300/600	9
DeHavilland –6 (Twin Otter)	A-II	75/100	3,000	300/600	19
CASA 212-300	A-II	75/100	2,950	300/600	26
DeHavilland –8 (DASH 8Q200 & 300)	A-III	100/100	3,800	600/800	35
Piper PA31 (Navajo)	B-I	60/75	3,500	240/600	9
Raytheon (Beech) C99	B-I	60/75	3,300	240/600	9
Beech King Air	B-II	60/75	3,500	240/600	6-8
Raytheon (Beech) BE1900	B-II	75/100	3,740	300/600	19
SAAB 340B	B-II	75/100	4,400	300/600	30

Note: Under runway width "visual runways with not lower than ¾ statute mile approach visibility/ runways with lower than ¾ statute mile approach visibility. Safety area beyond the runway end."

Source FAA AC 150/5300-13

Table 3-14 Design Aircraft for Y-K Aviation Plan

Passengers	Cargo Lbs	Design Airplane	Runway*	ARC
6-seat	1,200	Cessna 207	1,800 feet	A-I
9-seat	2,200	Piper Navajo Chieftain	3,600 feet	B-I
11- to 13-seat	3,600	Beechcraft 99 or Raytheon Beech King Air 300 or 350 or Cessna Grand Caravan	3,300 feet	B-I
19-seat	5,700	Beech 1900	4,000 feet	B-II
30-seat	10,000	DeHavilland–8 (Dash 8) 300	3,600 feet	
30-seat	8,500	SAAB 340	4,400 feet	B-II
Hub	28,000	DC6	4,500 feet	B-III

* Runway lengths are for fully loaded aircraft take-off at sea level ISA.

Note: Beechcraft 99, Raytheon Beech King Air 300, and Grand Caravan are included as potential Part 135 aircraft with 9 passengers as an alternative to the Piper PA 31.

Figure 3-10 Anticipated Aircraft for Future Y-K Delta Operations
(Clockwise from Top Left: Dash-8 [ERA Aviation]; Grand Caravan [Peninsula Airways]; Beech 1900 [Alaska Cargo Express]; CASA 212 [Bering Air]; SAAB 340 [Peninsula Airways])

3.5 Unconstrained Evolution of the Carrier Markets

Having assessed demand and examined aircraft that might be employed by Alaska air carriers to meet demand, the next stage in the examination is how aircraft might be used to meet demand if there are no constraints placed on runways. This analysis assumes all airports will be brought up to standards as soon as possible, and then examines potential routes and competition between air carriers.

Important assumptions include:

- Air carriers will continue to fly routes similar to the ones they fly now including serving more than one village on a run from Bethel. The routes are structured from practical operational characteristics of routes shown in the Official Airline Guide (OAG).
- Air carrier flight schedules will remain roughly the same; added demand will be accommodated with larger aircraft. The schedule is weekly and the number of flights will generally remain the same because of the limited number of pilots and operating hours.
- Air carriers will generally maintain a reasonable load factor of >60%, a load factor common to most national markets.
- Aircraft speed will remain important to airlines serving the coastal communities from Bethel because of limited winter daylight operating hours.
- Air carriers will increase seats to serve growing demand.
- Improvements in IFR capabilities will make flights more reliable.

The process for developing the market analysis was to review the OAG as the expression of the daily scheduled flights of the various carriers over a week. Combining the schedule with aircraft presently employed in major markets determined the number of seats available.

The demand every five years from 2000 to 2020 was then examined in each of the routes. When demand reaches a level that exceeds 60% of the available seats, then the number of seats to be added is identified. At this point it becomes necessary to estimate the fleet mix of 7-, 9-, 19-, and 30-passenger aircraft that might be employed to meet the demand. Once the fleet evolution was assumed, runway changes, including when they needed to occur, could be identified.

3.5.1 Illustrative Scenario

The trip from Bethel to Chevak to Hooper Bay to Scammon Bay and return to Bethel was chosen to illustrate the model.

Because the route chains several villages, the airport with the *shortest runway* in the chain determines the aircraft that can be used. Travel demand from the three villages to Bethel was used to forecast capacity. Table 3-15 shows the data for this route from the OAG. Four air carriers are currently flying the route with 290 seats. However, the DeHavilland (DHT) twin otter can be outfitted with 19 seats, raising that total to 412 seats per week. With mail/air freight volumes also

increasing, it is unlikely that the twin otters would be used in the 19-seat configuration, but it is expressed in Table 3-15 to show the full range of passenger capacities.

The number of seats needed for this route were determined by using the demand forecast for Bethel trips to and from Chevak, Hooper Bay, and Scammon Bay and then applying the 60% load factor criterion. The final step maintains the daily flight schedule and an aircraft scenario using the appropriate design aircraft that was proposed as shown in Table 3-16.

The twin otter will be the first to extend to 19 seats and in 2010, another 19-seat aircraft will be needed. Eventually all three runways will need to accommodate 30-passenger aircraft for the villages to receive the service indicated.

The scenario above suggests that all the runways should eventually go to 4,000 x 100 feet (4,400 with SAAB 340). As is true with each major project, DOT&PF prepares or reevaluates and updates Airport Master Plans. One consideration is the cost/benefit of whether it is better to lengthen the runway to 4,500 feet initially, or to phase the airport expansions as capacity limits are approached. Most coastal villages probably benefit from a single construction effort because of the high cost of mobilization, which has been estimated as high as 30% of contracting cost.

All route structures in the Y-K Delta were evaluated using the OAG. No route was found as demanding as the Hooper Bay–Chevak–Scammon Bay route, although many routes will require the capability for 9-passenger aircraft operations in the next 5 to 10 years. The present construction program calls for at least 3,300- by 60-foot runways to meet 9-passenger requirements. Table 3-17 indicates how the aircraft fleet evolution approach influences airport design.

Table 3-15 Carrier Scheduled Activity for the BET-VAK-HPB-SCM-BET Flights — 1999

Bethel–Chevak–Hooper Bay–Scammon Bay–Bethel										
CARRIER	**M**	**T**	**W**	**R**	**F**	**S**	**S**	**EQUIP**	**SEATS/A/C**	**WEEKLY SEATS**
A	●	●	●	●	●	●	●	DHT	19 / 9	133 /63
C	●	●	●	●	●	●		207	6	36
B	●	●	●	●	●			PAG	5	25
B						●	●	PAG	3	6
D	●	●	●	●	●	●		208	9	54
C	●	●	●	●	●	●		207	6	36
A	●	●	●	●	●			DHT	19 / 9	95 /45
B	●	●	●	●	●			206	5	25
PER WEEK										**412 / 290**
PER YEAR										**21320 / 21200**

Source: Official Airline Guide, November 1999

Note: Sometimes the itinerary is flown in reverse, putting Scammon Bay as the first stop.

Table 3-16 How the Fleet Mix Could Grow to Meet Demand

Bethel–Chevak–Hooper Bay–Scammon Bay–Bethel							
Year	Needed Enplanements to Bethel	Seats Required if Load Factor is 60%	Fleet Mix Number of Aircraft by Size				Length of Runway (ft)
			5–6	9	19	30	
1995	8,004	257	7				3,000
2000	10,963	351	5	2 Twin Otter			3,000
2005	14,412	462	2	3	2 Twin Otter		3,300
2010	19,400	622		3	2 Twin Otter+2		4,000
2015	22,000	705		3	3	1*	4,400[a]
2020	28,200	900			5	2*	4,400

a The 30 seat aircraft, SAAB 340, because it requires a longer runway, may not come on line this early, but it will be a part of the fleet eventually. The Dash 8, however, is also a major possibility and requires less than a 4,000-foot runway.

Table 3-17 One Schedule for Runway Improvements

Village	Present	2005	2010	2015
Chevak	3,300 x 60	3300 x 60	4,000 x 75	4,400 x 100[a]
Hooper Bay	3,300 x 75	4500 x 100	4,500 x 100	4,500 x 100
Scammon Bay	3,000 x 75	3300 x 60	4,000 x 75	4,400 x 100[a]

a If SAAB 340 is the design aircraft, otherwise 4,000.

3.6 Developing the Plan

Villages are often served in clusters. The cluster arrangement for the Y-K Delta is indicated in Table 3-18. To determine runway dimensions needed for each cluster, air traffic was examined. For each cluster, an analysis similar to the one above was carried out. The results are shown in Table 3-20 and in the short narrative that follows for each cluster. With a few exceptions, the clusters correspond to the patterns that exist in the runway recommendation chart shown in Figure 3-11.

Table 3-18 Clusters for the Y-K Delta, using 2000 Census Data

Hubs	7,897	Cluster 1	4,081	Cluster 2	616	Cluster 3	400
Bethel City	5,532	Akiachak	585	Chuathbaluk	119	Lime Village[a]	54
w/Oscarville		Akiak	309	Upper Kalskag	230	Sleetmute	100
St. Mary's	625	Atmautluak	294	Lower Kalskag	267	Red Devil	48
Pitka's Point		Kasigluk	543	Crooked Creek	137		
Aniak	572	Kwethluk	713	Stony River	61		
Emmonak	767	Napakiak	353				
McGrath	401	Napaskiak	390				
		Nunapitchuk	466				
		Tuluksak	428				
Cluster 4	**159**	**Cluster 5**	**1,654**	**Cluster 6**	**950**	**Cluster 7**	**1,407**
Takotna	50	Mt. Village	755	Holy Cross	227	Nunam Iqua	164
Nikolai	100	Pilot Station	550	Anvik	104	Alakanuk	652
Flat	4	Marshall	349	Russian Mission	296	Kotlik	591
Telida	5	Shageluk	129				
		Grayling	194				
Cluster 8	**2,244**	**Cluster 9**	**1,902**	**Cluster 10**	**2,634**	**Cluster 11**	**271**
Hooper Bay	1,014	Quinhagak	555	Kipnuk	644	Goodnews Bay	230
Chevak	765	Kwigillingok	338	Chefornak	394	Platinum	41
Scammon Bay	465	Kongiganak	359	Nightmute	208		
		Eek	280	Toksook Bay	532		
		Tuntutuliak	370	Tununak	325		
				Mekoryuk	210		
				Newtok	321		

a Estimate, Lime Village Census showed six

The analysis of individual clusters following the example given for the Hooper Bay–Chevak–Scammon Bay is the subject of Appendix E. Increases in seats trigger the change in aircraft, which in turn dictates the future runway length. A clear idea as to the timing for meeting the next level of increase, namely, the

19-passenger aircraft was developed from the demand forecast presented in Section 3.2. In making this judgment, a conservative element has been incorporated by simply requiring the fleet to require two 19-passenger aircraft (not one) before triggering the runway increase to 4,000 feet.

Cluster 1. The traffic between Bethel and villages within 30-minute flight time will almost double by 2020. These airports can be 3,300- x 60-foot runways. In 2010, two additional daily flights will be required and by 2020, if the runways are still limited to 3,300 feet, 192 seats will be required daily, meaning either additional flights or larger aircraft. The strategy for Cluster 1 airports will be to increase the number of daily flights first, and increase aircraft size second. The same aircraft and pilots could be used for extra round trips given the short flight distance involved. These villages have the added advantage of more transport alternatives.

Finding: Improve all runways to 3,300 x 60 feet as soon as possible.

Cluster 2. For these villages, the present service will need to be upgraded to 9-passenger aircraft.

Finding: Improve all runways to 3,300 x 60 feet as soon as possible.

Cluster 3. Upriver travel is mostly to Aniak and can be served throughout the planning period with the present services upgraded to 9-passenger aircraft. However, the need to fly fuel into Lime Village requires a 4,000- x 100-foot runway to accommodate fuel delivery by DC-6.

Finding: Increase all runways to 3,300 x 60 feet as soon as possible; extend the Lime Village runway to 4,000 x 100 feet.

Cluster 4. Like Lime Village, this village cluster requires fuel supplies carried in by DC-6.

Finding: Increase all runways to 4,000 x 100 feet as soon as possible.

Cluster 5. Enplanements in this area will require 19-seat aircraft by 2015. In the meanwhile, upgrading all runways to 3,300 x 60 feet will accommodate 9-passenger aircraft by 2005.

Finding: Increase all runways to 3,300 x 60 feet as soon as possible. Plan for all runways to 4,000 x 100 feet by 2015.

Cluster 6. For these villages, present service will need to be upgraded to 9-passenger aircraft.

Finding: Improve all runways to 3,300 x 60 feet as soon as possible.

Cluster 7. All runways meet aircraft requirements. 19-seat aircraft and longer runways will be needed by 2015.

Finding: Lengthen Alakanuk runway to 4,000 x 100 feet by 2015. Nunam Iqua will be served by feeder service from Emmonak; a 3,300- x 60-foot runway is adequate for that service.

Cluster 8. All runways meet aircraft requirements. Four 19-seat aircraft will be needed by 2015; one 30-passenger aircraft may be needed in 2020. Hooper Bay and its close proximity to Chevak is a

large population center on the coast. Hooper Bay is a candidate to become a postal hub or mainline route, which requires 4,000-x 100-foot runways to accommodate DC-6s.

Finding: All runways to 4,000 x 100 feet for Dash 8 (4,400 for SAAB 340) by 2010, Hooper Bay to 5,000 feet if a mainline route or mail hub is established.

Cluster 9. Enplanement growth in this area will require 19-seat aircraft by 2015.

Finding: Improve all runways to 3,300 x 60 feet as soon as possible. Quinhagak may go to 4,500 x 100 feet by 2005 to permit increased mail/cargo haul and passenger service.

Cluster 10. These villages form a market segment that has a variety of flights/ routes. Toksook Bay, Chefornak, and Kipnuk will likely require 19-passenger aircraft by 2010. If Mekoryuk continues to build its CDQ fisheries, the runway will need to be upgraded 4,500 x 100 feet for fully loaded DC-6 operations.

Finding: Improve all airports to 3,300 x 60 feet as soon as possible. Increase runways at Toksook Bay, Chefornak, and Kipnuk to 4,000 x 100 feet by 2010.

Cluster 11. These villages can be served with the evolving 9-passenger aircraft fleet.

Finding: Improve all runways to 3,300 x 60 feet as soon as possible.

It should also be noted that this is a plan based on information current at this time. As any airport is considered for a change in runway length, width, or any other major investment, a Revised Airport Master Plan or at least a new Airport Layout Plan (ALP) is required. This action would bring out specific factors that need to be considered.

Figure 3-11 shows the recommended changes and Table 3-20 gives more information about the runway analysis. Each airport in the Y-K Delta is listed along with its dimension data and the latest available data on population, enplanements, and mail, airfreight, and cargo. Proposed runway expansions and their forecast dates are provided along with planning-level cost estimates. If a village has a runway project in the Airport Improvement Plan (AIP), that is also indicated. Dates for improvements may move forward with increased FAA funding, or lag if funding is decreased.

The forecasted year of introduction by aircraft type for each cluster is shown in Table 3-19.

Table 3-19 Introduction Year for Aircraft Type

Cluster		9-Seat Aircraft	19-Seat Aircraft	30-Seat Aircraft
1	Close to Bethel	2000 (see Note 1)*		
2	Bethel Service	2010		
3	Aniak Service	See Note 2		
4	McGrath Service	See Note 2		
5	Bethel/St. Mary's	2005	2015	2020?
6	Holy Cross related	See Note 2		
7	Emmonak Service	2000	2015	
8	Hooper Bay Bethel Service	2000	2000	2015
9	Quinhagak Service Sub Hub?	2000	2005 (KWN)	
10	Toksook Bay Service	2000	2010	2020?
11	Platinum/Goodnews Bay	2010		

Note 1: Villages near Bethel can be served by smaller aircraft due to their proximity to the hub. It is clear from insurance and operation considerations that most of the passenger service by Cessna 206/207 single-pilot, single-engine, piston-driven aircraft will eventually be replaced by Cessna Caravan turbine aircraft with 1 pilot and 9 passengers, or 2 pilots and up to 13 passengers.
Note 2: The demand in these areas will probably not exceed the capabilities of 9-passenger aircraft.

3.7 Airport Planning

Each airport must be examined as to the best way to accomplish recommended changes. For many airports, it is adequate to bring runways up to 3,300 x 60 feet. For some runways, there is adequate land to extend the runway and still provide for the FAA-required Protection Zones. Other runways, such as those in Eek, Tuntutuliak, Stony River, and Takotna, (Figure 3-12) have terrain situations that make it virtually impossible to extend them without relocating them. The alternate site for Eek has already been located and Stage 1 construction is complete. For airports located by tundra and coastal villages, the construction technique is to "push up" soil so it can drain for two to three years. Stage 2 construction consists of grading and covering the sub-base with 10 to 20 inches of base course gravel, usually delivered by barge.

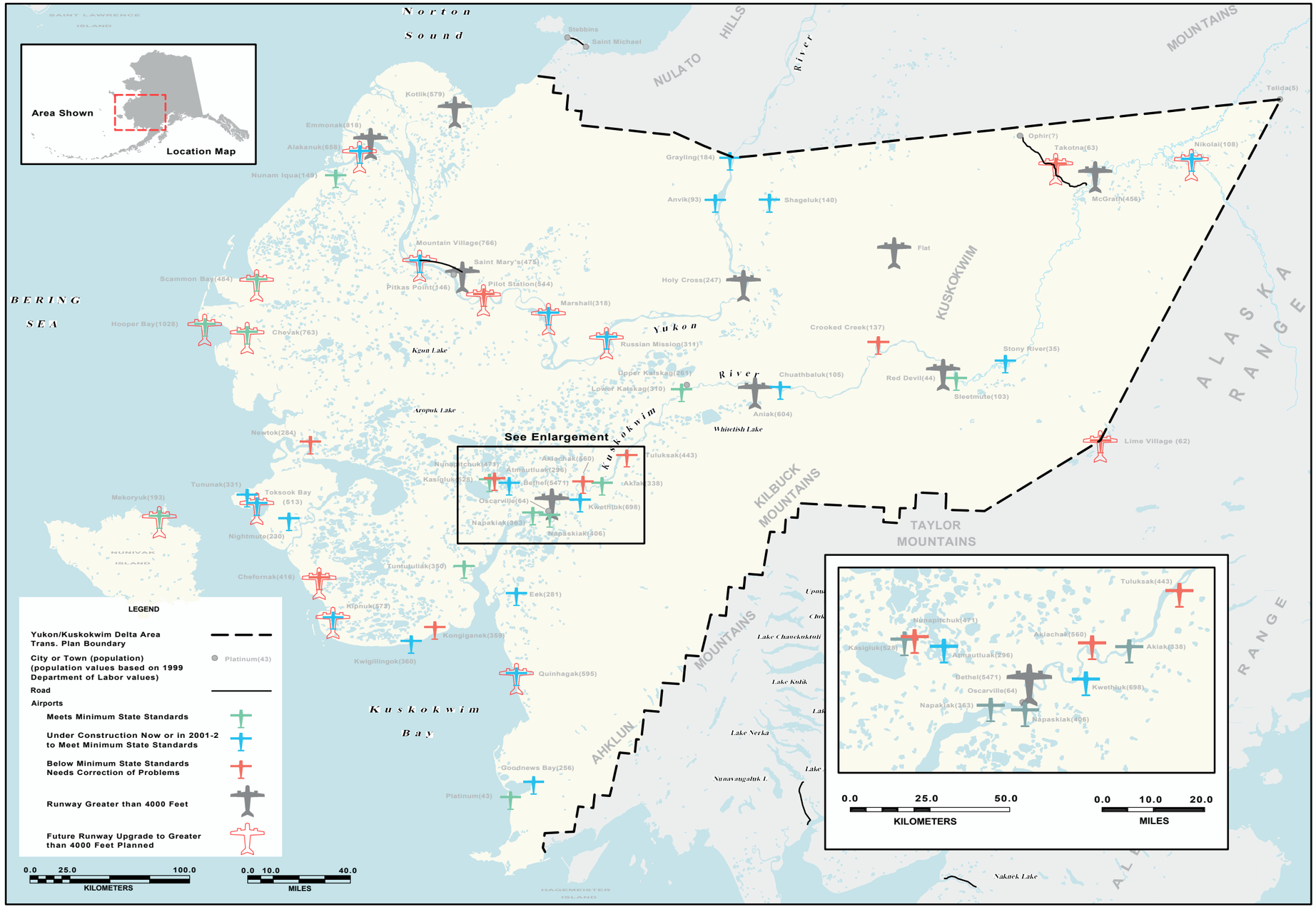


Figure 3-11 Y-K Delta Airports and Recommended Changes (AK DOT&PF)

Village	2000 Census	AIrMi –Hub	Present R/W	Min R/W Needed	Date Needed	Reason for Need	Project Status
BETHEL — (Hub)							
Bethel (Major Hub) (Incl Oscarville)	5,532	NA	6,398 x 150 Precision App.	OK	Continued Improvement	Regional Hub Airport	Master Plan Being Implemented
VILLAGES NEAR BETHEL — HUB (Bethel)							
Akiachak	585	14	1625 x 50	3300 x 60	ASAP	9 Passengers	Local Sponsor
Akiak	309	20	3200 x 60	3300 x 60	—	9 Passengers	Complete
Atmautluak	294	19	2000 x 40	3300 x 60	ASAP	9 Passengers	In Construction
Kasigluk	543	24	3200 x 60	3300 x 60	—	9 Passengers	Complete
Kwethluk	713	14	1700 x 40	3300 x 60	ASAP	9 Passengers	In Construction
Napakiak	353	12	3200 x 60	3300 x 60	—	9 Passengers	Complete
Napaskiak	390	6	3000 x 60	3300 x 60	—	9 Passengers	Complete
Nunapitchuk	466	23	2040 x 60	3300 x 60	ASAP	9 Passengers	Terrain Limits to 2500ft.
Oscarville	61	6	No Airport	Service from Napaskiak and Bethel			
Tuluksak	428	37	2500 x 30	3300 x 60	ASAP	9 Passengers	In Master Plan
ANIAK PLUS NEARBY VILLAGES ON KUSKOKWIM — HUB (Aniak)							
Aniak	572	0	6000 x 150	6000 x 150	N/A	USPS Hub	Complete
Chuathbaluk	119	11	1560 x 60	3300 x 60	ASAP	9 Passengers	Construction 2003
Crooked Creek	137	47	2000 x 60	3300 x 60	ASAP	9 Passengers	Terrain Limits / Master Plan
Kalskag	497	26	3300 x 60	3300 x 60	—	9 Passengers	Complete
Red Devil	48	76	4750 x 74	4500 x 100	—	Fire / Resource	Complete
Sleetmute	100	82	3100 x 60	3300 x 60	—	9 Passengers	Complete
Stony River	61	100	2555 x 60	3300 x 60	ASAP	9 Passengers	Construction 2003
McGRATH PLUS NEARBY VILLAGES — HUB (McGrath)							
McGrath	401	0	5200 x 150	5200X150	—	USPS Hub	Complete
Takotna	50	14	1717 x 65	4000 x 75	ASAP	Fly Fuel	Relocate / Master Plan
Nikolai	100	46	2350 x 60	4000 x 75	—	Fly Fuel	Complete
Flat	4	77	4045 x 114	4000 x 75	—	Fly Fuel	Complete
Lime Village	6 (≈62)	110	1475 x 60	4000 x 75	ASAP	Fly Fuel	In Master Plan
LOWER-MID YUKON SERVED BY ANIAK — HUB (Aniak)							
Anvik	104	77	2910 x 75	4000* x 60	ASAP	9 Passengers	Construction 2004
Grayling	194	95	2315 x 60	4000* x 60	ASAP	9 Passengers	Construction 2005
Holy Cross	227	40	4000 x 100	4000 x 100	—	19 Passengers	Complete
Russian Mission	296	60	2700 x 50	3600* X 75	—	9 Passengers	Complete
			3600 x 75	4000 x 100	2010	19 Passengers	Terrain Limit Investigation
Shageluk	129	76	2300 x 50	3600* x 60	ASAP	9 Passengers	In Construction to 3600 feet
LOWER-YUKON SERVED BY ST. MARY'S — HUB (St. Mary's or Bethel)							
Saint Mary's incl Pitkas Point	625	0 or 98	6003 x 150	6000 x 150	—	USPS Hub	Complete
Marshall	349	27 or 75	1940 x 30	4000* x 100	—	19 Passengers	Complete

Table 3-20 Y-K Delta Airport Status Chart

Village	2000 Census	AIrMi –Hub	Present R/W	Min R/W Needed	Date Needed	Reason for Need	Project Status
Mountain Village	755	18 or 110	2500 x 60	3300 x 60	ASAP	9 Passengers	Construction 2004
			3300 x 60	3500 x 75	2005	19 Passengers	Terrain Limited
Pilot Station	550	12 or 87	2520 x 55	4000* x 75	2005	19 Passengers	Construction beyond 2005
UPPER COASTAL — HUB (Emmonak)							
Emmonak	767	0	4400 x 75	4400 x 100	—	USPS Hub	Complete
Alakanuk	652	8	2200 x 55	4000* x 75	ASAP	19 Passengers	In Construction
Nunam Iqua	164	21	3000 x 60	3300* x 60	—	9 Passenger	Complete
			3300 x 60	4000 x 75	2018	19 Passengers	New Master Plan Needed
Kotlik	591	34	4400 x 100	4000* x 75	—	19 Passengers	Complete
MIDDLE COASTAL — HUB (Bethel)							
Hooper Bay	1014	151	3300 x 75	4400 x 100	2004	Future Hub	In Master Plan
Chevak	765	135	2600 x 40	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
Scammon Bay	465	144	3000 x 75	3300 x 60	—	9 Passengers	Complete
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
LOWER-MIDDLE COASTAL — HUB (Bethel)							
Chefornak**	394	90	2500 x 35	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
Kipnuk**	644	96	2120 x 35	3300 x 60	ASAP	9 passengers	In Construction*
			3300 x 60	4000 x 75	2015	19 Passengers	Present Terrain Limit to 3300
Mekoryuk	210	150	3070 x 75	3300 x 100	—	9 Passengers	Complete
Newtok	321	95	2010 x 40	3300 x 60	ASAP	9 Passengers	On Hold
Nightmute	208	101	1600 x 40	3300 x 60	ASAP	9 Passengers	Construction 2003
Toksook Bay	532	112	1800 x 55	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4400 x 100	2015	USPS/Cargo Hub?	New Master Plan Needed
Tununak	325	117	2010 x 40	3300 x 60	ASAP	A/P Capability	Construction 2004
KUSKOKWIM BAY & SOUTH COASTAL — Hub (Bethel)							
Eek**	280	40	1400 x 35	3300 x 60	ASAP	9 Passengers	In Construction
Kongiganak	359	76	1880 x 35	3300 x 60	ASAP	9 Passengers	Local Sponsor
Kwigillingok	338	78	2500 x 35	3300 x 60	ASAP	9 Passengers	Local Sponsor
Quinhagak	555	72	2600 x 60	3300 x 60	ASAP	9 Passengers	In Construction/Local Sponsor
			3300 x 60	4500 x 100	2010	Fish Haul	Local Sponsor
Tuntutuliak**	370	40	1800 x 28	3300 x 60	ASAP	9 Passengers	In Construction
Platinum	41	116	3640 x 60	3300 x 60	—	Mining Transport	Complete
Goodnews Bay**	230	130	2850 x 80	3300 x 80	ASAP	9 Passengers	On Hold

Notes:
Although the State Standards are now 3300 feet runway length, all runways in excess of 3000 feet are shown as complete.
ALP is Airport Layout Plan
* Runways for villages served primarily by 9 passenger Navajo aircraft require longer than state standard.(minimum 3600, 4000 for safety)
** Airports being constructed in two stages. Stage one is soil preparation. Drainage usually takes 2-4 years before construction can be completed.

Table 3-20 Y-K Delta Airport Status Chart (continued)

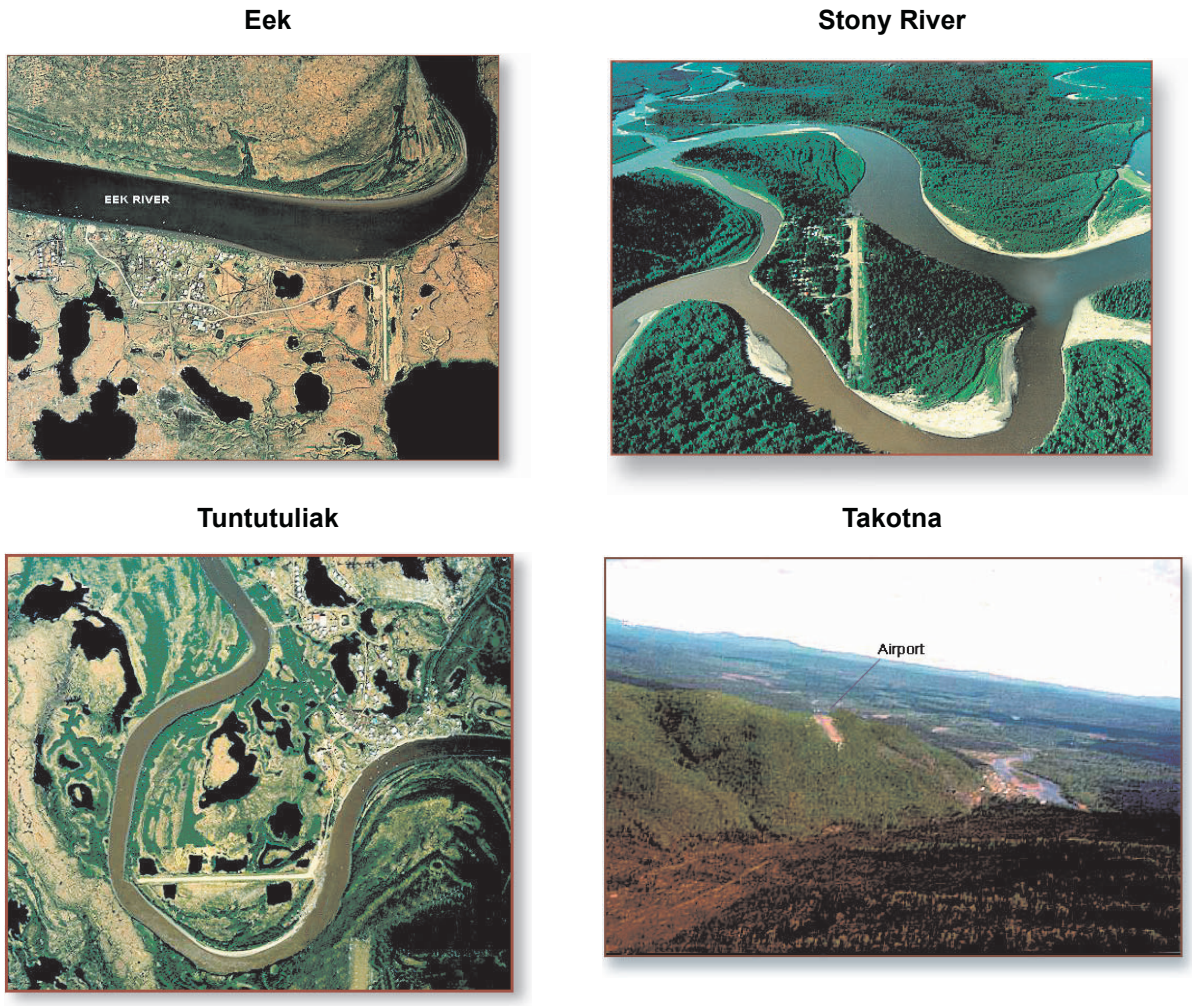


Figure 3-12 Eek, Stony River, Tuntutuliak, and Takotna Airports

Each airport has a unique set of characteristics; some have land problems; others have more than the usual geometric gradients; and some are in locations where approach patterns are special and/or limited to daylight.[4] The implication is that upgrading these runways is essential but, because of the conditions, construction can be expensive and maintenance costs high.

Other airports, like those at Alakanuk and Emmonak (Figure 3-13), are located in places where flooding makes them unusable or unreachable during the spring. These may need to be moved, the elevation increased, or the access road alters so that it is passable year-round. Figure 3-14 shows examples of a number of airports that need extension or relocation during the planning horizon.

4. See the FAA website, http:// www.alaska.faa.gov/fai/airports2.htm, for Alaska airport photos.

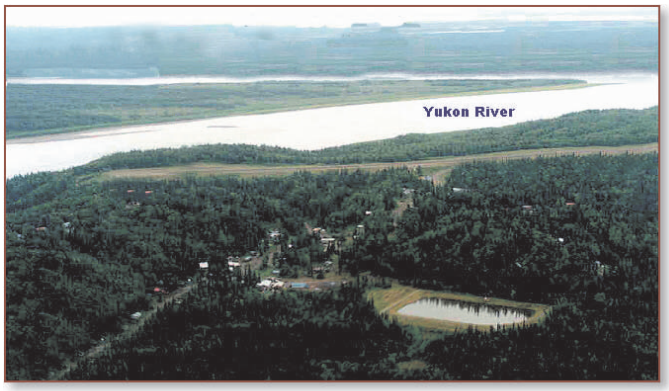
Alakanuk

Emmonak

Figure 3-13 Alakanuk and Emmonak Airports at Flood Stage

Nunapitchuk

Anvik



Aniak

Chefornak

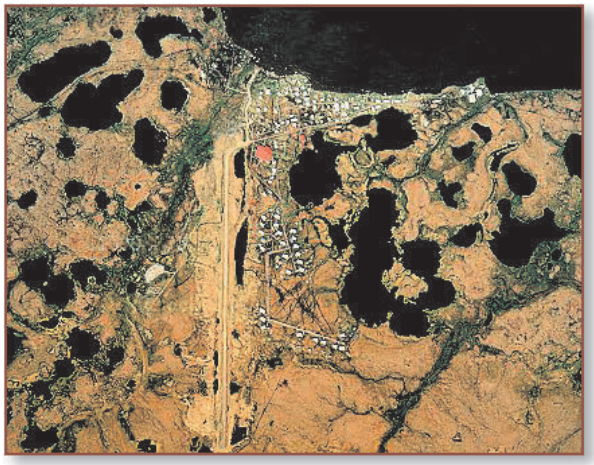
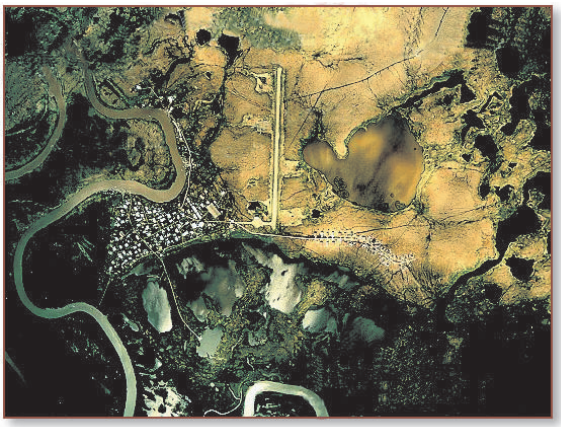
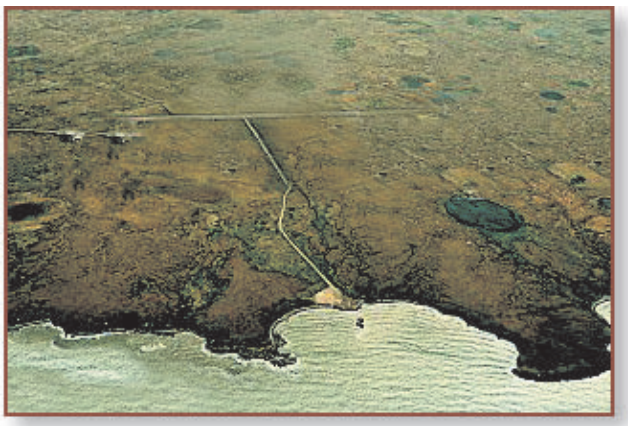


Figure 3-14 Airports of the Y-K Delta

Kongiganak



Mekoryuk



McGrath

Kipnuk

Bethel

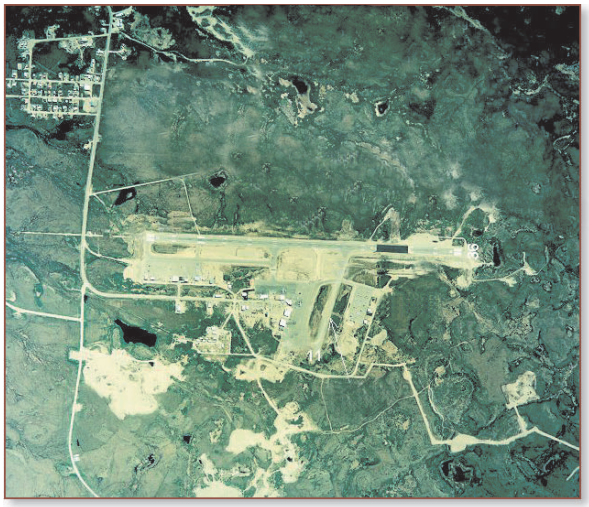


Figure 3-14 Airports of the Y-K Delta (continued)

3.8 Funding Airport Improvements

The FAA's *National Plan of Integrated Airport Systems, 1998 to 2002* (NPIAS) is used by federal and state aviation officials to help guide funding decisions. The NPIAS categorizes airports depending mainly on the number of annual enplanements at each. There are Hubs (large, medium and small), and Reliever Airports. There are 413 primary (272 non-hubs) and commercial airports eligible for federal funding at different levels of support. Most of the money is used for the more active airports (10,000 enplanements and higher). Table 3-21 below from the NPIAS shows that breakdown.

Bethel is listed as 207th and Aniak as 372nd ranked primary airports. The list of 125 airports are considered Commercial Service Airports with annual enplanements between 2,500 and 10,000 persons. Using year 2000 enplanements, the Y-K Delta has 24 airports in this category. If the forecast for enplanements holds (and the criteria stays fixed), there will be four more primary airports in the Y-K Delta in 2020. These will be Hooper Bay, Mountain Village, Alakanuk, and Pilot Station. In addition eight more will achieve commercial status. The airports are listed in Table 3-22.

The FAA funding formulae do not take into account either construction difficulties or the fact that airports are primary transportation links for both people and most freight required in the village. If the equivalent weight of goods flown in (200 pounds per person) were used in computing the equivalent airport enplanements, nine more Y-K Delta airports would become eligible for Primary Airport status, *presently determined only by 10,000 or more enplanements per year.* These are Hooper Bay, Mountain Village, Chevak, Alakanuk, Pilot Station, Kotlik, Quinhagak, Toksook Bay, and Kipnuk. This would require a major change to the FAA criteria governing funding.

By virtue of increases in enplanement activity by 2020, the Y-K Delta will have the airports in the categories shown in Table 3-23.

Table 3-21 Categorization and Distribution of Activity for NPIAS Airports

Number of Airports	Airport Type	Airport Percent of National Enplanements E	Percentage of All Enplanements	Percentage of active GA aircraft
29	Large Hub Primary	E >1%	67.3	1.3
42	Medium Hub Primary	0.5%≥E > 1%	22.2	3.8
70	Small Hub Primary	0.05%≥ E > 0.25%	7.1	4.7
272	Non hub Primary	10,000 ≥ E > 0.05%	3.3	11.4
125	Other Commercial	2,500 ≥ E >10,000	0.1	2.1
334	Relievers		0.0	31.5
2,472	General Aviation		0.0	37.3
3,344	Total Existing NPIAS		100.0	92.1
15,000	Low Activity Landing Sites (Non-NPIAS)		0.0	7.9

Source: FAA: National Plan of Integrated Airport Systems (1998 to 2002) Table 1

Table 3-22 Categories of Y-K Delta Airports in the NPIAS

		Primary Airports Enplanements				Commercial Airports Enplanements			
2000 Actual		2005 Forecast		2010 Forecast		2015 Forecast		2020 Forecast	
City	No.	City	No.	City	No.	City	No.	City	No.
Bethel	125,885	Bethel	159,500	Bethel	187,000	Bethel	215,000	Bethel	242,600
Aniak	17,194	Aniak	21,000	Aniak	23,300	Aniak	25,800	Aniak	28,500
St. Mary's	7,126	St. Mary's	7,700	Mt. Village	8,700	Hooper Bay	11,100	Hooper Bay	13,400
Emmonak	5,981	Mt. Village	6,980	Hooper Bay	8,600	Mt. Village	10,300	Mt. Village	13,000
McGrath	5,487	Hooper Bay	6,730	St. Mary's	8,300	St. Mary's	9,000	Alakanuk	10,000
Mt. Village	5,448	Emmonak	6,200	Emmonak	6,900	Pilot Station	8,800	Pilot Station	10,000
Hooper Bay	5,104	McGrath	5,600	Pilot Station	6,900	Alakanuk	8,200	St. Mary's	9,700
Kipnuk	4555	Alakanuk	5,405	Alakanuk	6,680	Chevak	7,900	Chevak	9,500
Kalskag	4,146	Chevak	5,360	Chevak	6,500	Emmonak	7,600	Kotlik	8,500
Chevak	4,141	Kipnuk	5,300	Kipnuk	6,100	Toksook Bay	7,300	Toksook Bay	8,500
Alakanuk	4,054	Pilot Station	5,260	McGrath	6,000	Kipnuk	7,000	Emmonak	8,300
Pilot Station	3,903	Kalskag	4,850	Kalskag	5,750	Kotlik	7,000	Kalskag	8,000
Toksook Bay	3,516	Toksook Bay	4,750	Kotlik	5,700	Kalskag	6,800	Kipnuk	8,000
Kotlik	3,511	Kotlik	4,620	Toksook Bay	5,600	McGrath	6,400	Kasigluk	7,500

Table 3-22 Categories of Y-K Delta Airports in the NPIAS (continued)

		Primary Airports Enplanements				Commercial Airports Enplanements			
2000 Actual		2005 Forecast		2010 Forecast		2015 Forecast		2020 Forecast	
City	No.	City	No.	City	No.	City	No.	City	No.
Tuntutuliak	3,401	Kasigluk	4,110	Kasigluk	5,200	Kasigluk	6,400	Scammon Bay	7,500
Kwigillingok	3,209	Kwethluk	4,010	Kwethluk	5,100	Scammon Bay	6,300	Kwethluk	7,200
Tuluksak	3,072	Tuntutuliak	4,010	Scammon Bay	4,950	Kwethluk	6,000	Tuluksak	7,200
Kongiganak	3,041	Nunapitchuk	3,860	Nunapitchuk	4,700	Tuluksak	5,900	Marshall	7,000
Chefornak	3,022	Scammon Bay	3,780	Tuluksak	4,700	Marshall	5,700	McGrath	6,800
Scammon Bay	3,022	Kwigillingok	3,750	Tuntutuliak	4,560	Nunapitchuk	5,550	Akiachak	6,500
Kwethluk	2,971	Tuluksak	3,670	Marshall	4,500	Akiachak	5,400	Nunapitchuk	6,500
Kasigluk	2,805	Kongiganak	3,600	Akiachak	4,400	Tuntutuliak	5,200	Russian Mission	6,500
Nunapitchuk	2,772	Chefornak	3,540	Kongiganak	4,300	Kongiganak	5,100	Kwigillingok	6,200
Marshall	2,711	Marshall	3,480	Kwigillingok	4,300	Kwigillingok	5,100	Kongiganak	6,000
Akiachak	2,681	Akiachak	3,340	Chefornak	4,100	Russian Mission	5,100	Quinhagak	6,000
Russian Mission	2,519	Russian Mission	3,020	Russian Mission	3,900	Quinhagak	4,900	Tuntutuliak	6,000
Quinhagak	2,362	Atmautluak	2,865	Quinhagak	3,700	Chefornak	4,600	Chefornak	5,300
Atmautluak	2,355	Quinhagak	2,800	Atmautluak	3,500	Atmautluak	4,200	Atmautluak	4,900
Akiak	1,910	Akiak	2,700	Akiak	3,450	Akiak	4,100	Akiak	4,800
Mekoryuk	1,887	Holy Cross	2,400	Holy Cross	2,900	Nightmute	3,400	Nightmute	4,300
Nunam Iqua	1,843	Newtok	2,320	Newtok	2,830	Holy Cross	3,300	Tununak	4,000
Holy Cross	1,794	Mekoryuk	2,290	Tununak	2,650	Newtok	3,300	Holy Cross	3,800
Napaskiak	1,754	Tununak	2,050	Mekoryuk	2,600	Tununak	3,200	Newtok	3,800
Newtok	1,754	Goodnews	2,000	Nightmute	2,600	Mekoryuk	3,000	Mekoryuk	3,600
Tununak	1,635	Nightmute	2,000	Nunam Iqua	2,470	Nunam Iqua	2,900	Napakiak	3,600
Nightmute	1,311	Nunam Iqua	2,000	Goodnews	2,400	Napakiak	2,800	Nunam Iqua	3,500
Napakiak	1,125	Eek	1,710	Napakiak	2,200	Goodnews	2,750	Goodnews	3,200
Goodnews	1,119	Napakiak	1,700	Eek	1,900	Eek	2,100	Shageluk	2,500

Table 3-23 Category of Airports in Y-K Delta

Airport Category	2000	2020
Primary Airports	2	6
Commercial Airports	24	32
Utility Airports		
Stage II ≥[a]1000 enplanements	14	7
Stage I<1000 enplanements	13	8

a Airports with over 1,000 enplanements fit in the Stage II General Utility category. These are upper- scale General Aviation airports intended to support aircraft with up to 120 knots approach speed and 79 feet wingspan (ARC B-II), capable of precision approaches.

Section 4. Winter Trail Marking

4.1 Introduction

Winter weather conditions in the Yukon-Kuskokwim Delta (Y-K Delta) do not confine people to the indoors. Residents depend on subsistence fishing, hunting, and trapping to provide food and income throughout the winter. They also travel to hub communities for education and medical purposes and to buy consumer products and fuel. An important cultural tradition for many residents is traveling to other communities to visit friends and relatives, or to partake in potlatches during these months. Y- K Delta winter trails are as actively used as the road system in central Alaska.

There are few inter-community roads in the Y-K Delta, so during the winter, snow machines are the major mode of travel. However, the trails are also quickly erased by winds and blowing snow that occurs regularly in the Delta. Frequent whiteout conditions can make following trails nearly impossible.

Many lives have been lost because travelers lost their way in bad weather conditions, or were unable to reach their destinations due to mechanical or other problems. The risks are still high today.

Y-K Delta residents consistently expressed their desire to develop a well-marked winter trail system. Throughout the public involvement process, community representatives, especially the Elders, emphasized the importance of the trail system and gave many suggestions for safety improvements. Winter trail markers let travelers know distances to their destinations, lead disoriented travelers to the nearest village, and warn travelers about trail changes, including transitions from uplands to rivers or bays. The markers can also guide search and rescue teams to where lost travelers are mostly likely to be, reducing loss of life. Markers that are visible from the air become valuable aids in airborne search and rescue efforts.

Figure 4-1 Scammon Bay in Winter (http:akweathercam.faa.gov)

Most winter trail concerns center on the need for more trails to be marked, marking trails with more traditional materials, making sure the markers can be seen from the air, and having directional signs and reflectors.

Traditionally, trail markers of alders and willow were used to mark direction changes in the trails and to identify hazardous areas, but most stretches were unmarked. From the early 1970s to the mid-1980s, DOT&PF constructed trail markers and safe haven cabins for some winter trails in rural Alaska under the Local Service Road and Trails program. Driftwood tripods and colored blazes were added to the traditional alder and willow markers. This winter trail system relied heavily on local coordination and volunteer work, which was insufficient for the maintenance of the entire system.

4.2 Recent Projects

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 provided a new funding source for winter trails. In 1995, DOT&PF used ISTEA funds through Statewide Transportation Improvement Program (STIP) priorities to initiate projects linking 13 communities in the northwest Kuskokwim River area with about 600 miles of trail markers.

The first ISTEA winter trail-marking project marked approximately 200 miles of trail connecting Chefornak, Nightmute, Toksook Bay, and Tununak.

In 1996, another 300 miles connecting Chefornak, Kipnuk, Kwigillingok, Kongiganak, Tuntutuliak, and Fowler Island on the Kuskokwim River were installed. In 1997, projects added 100 miles of markers, connecting Chevak, Hooper Bay, Newtok, Nightmute, Scammon Bay, Toksook Bay, and Tununak.

In 1998, Congress passed the Transportation Equity Act for the 21st Century (TEA21). This legislation continues authorization for the State of Alaska to fund the winter trail marking projects with federal funds and the department's STIP continues a funding program for marking winter trails.

According to Yup'ik Eskimo construction crews, Route 66, the road through the heartland of America made famous by song and television, now has its counterpart in Alaska. They have playfully dubbed a recent reconstructed trail system on the Bering Sea Coast "Highway 66."

4.2.1 Trail Markers

The markers used under the ISTEA program consisted of a five-foot length of translucent plastic tube with reflective materials attached to a four-foot section of steel rod (rebar) with hose clamps and cold weather duct tape. These markers were placed no more than 500 feet apart with enough markers provided to place one every 200 feet, depending on the terrain and sight distance. Lake edges were not marked with signs to identify where the water begins for the travelers.

The supplies were shipped to each community where crews traveled by snowmachines with one day's supply of markers on sleds, often working under challenging winter conditions. Work could not be done in summer because the wet tundra soil and vegetation could not support vehicle or foot traffic.

The markers were not made from natural materials and they sometimes break from moisture freezing and thawing, becoming hazards when rebar is left sticking out of the frozen ground.

4.2.2 Project Management

All winter trail marking projects to date have been managed through sole-source contracts. Under this system, the department contracts with local entities that hire the labor and are accountable to DOT&PF. In the Y-K Delta, DOT&PF contracted with United Village Incorporated (UVI) for the 1995 project and with the Association of Village Council Presidents (AVCP) for the 1996 and 1997 projects.

Both UVI and AVCP are Alaska Native not-for-profit corporations providing public services to the area residents. UVI and AVCP administered the projects including hiring community residents, documenting payroll and other costs, and providing final reports to the DOT&PF upon completion of the projects. Future projects will likely continue to use local not–for–profit organizations for project administration.

Each community organized a three-person work team to accomplish the trail markings. These teams consulted Elders within the community to discuss the appropriate routes to be marked based on traditional use. The Elders also provided information on danger areas, difficulties experienced in the past with each route, and which routes tend to change due to blowing snow.

AVCP and UVI coordinated the work of the community teams to ensure that they were marking trails to a meet-up point between the communities. For example, the crew from Nightmute was responsible for marking one half of the distance of the trails between Nightmute and Toksook Bay, and between Nightmute and Chefornak, a total of about 60 miles. The crews from Chefornak and Toksook Bay marked their halves.

4.3 Village Concerns

Three major issues were consistent in public meetings throughout the region—local hire, safety (broadly defined as marking and locating), and ease of search and rescue.

Local hire. The village economies of the study area have relatively few year-round jobs. By contracting locally, more jobs will be brought into the village.

Safety. It is common for residents to lose their way on winter trails, especially when weather conditions change rapidly and unpredictably. Trail markers and directional signs provide visual aids to follow to the nearest community. Direction signs only at trail junctions are not adequate in storms or other adverse conditions.

Search and rescue. Marker position locations need to be mapped, the markers need to be visible from the air, and if possible, they need to be designed to provide some protection from the weather.

Global Positioning Satellite (GPS) technology offers great promise in increasing traveler safety on winter trails. Hand-held GPS receivers being used by an increasing number of travelers allow

people to determine where they are under any condition. This lets travelers rejoin trails if they lose the trail and gives direction information while on the trail. Search and rescue efforts are able to use GPS to reduce both search area and time by concentrating on trail areas no matter what the visibility conditions are along the trail.

Managers of two U.S. Fish and Wildlife Service National Wildlife Refuges in the study area (Togiak and Yukon Delta) have expressed concerns about maintenance of the markers. As a condition for issuing permits for markers in the refuges, managers required DOT&PF to develop maintenance agreements with all communities to maintain the portion of trail that they install. Future trail marking projects will require a maintenance agreement to be negotiated as a condition of the project construction as well.

4.3.1 Project Funding and Management

The Y-K Delta Plan winter trails funding and management recommendations are:

1. Continued funding through STIP for the construction of winter trails is a priority for DOT&PF.

   Currently, the winter trail system is incomplete; numerous trails already connecting communities are inadequately marked and maintained and other trails are needed to connect communities in a systematic way. Trails to major subsistence dispersal points were not considered in early planning, but have been included in recent trail marking proposals. The Y-K Delta has over 900 miles of trail marking needs.

2. It is also a priority at DOT&PF to continue to use a "force account" work style for projects.

   This method has reduced the costs of marking winter trails and provided much-needed employment for residents in the study area.

3. DOT&PF will continue to establish maintenance agreements with communities.

   Limited funds for maintenance and operation mean that communities must perform most maintenance.

4.3.2 Trail Marker Design and Mapping

With the emphasis on visibility and a more maintenance-free design, DOT&PF developed a standard design for trail marking, including reflective blazes and signage. Many features are drawn from a traditional design used on the annual Iditarod dog race trail. In the Nome area especially, the markers are a tripod design, spaced about 200 feet apart. These tripods are visible in almost all winter conditions and are easily visible from the air for search and rescue efforts. That successful design is now DOT&PF's design standard.

In addition, GPS coordinates will be noted on markers where feasible after the users of the trails agree on a standard system. This will enhance the ability of a traveler to ascertain his/her location and then follow the markers to a community. The tripod design will allow the traveler to wrap a tarpaulin or other cloth around the tripod and have a sheltered area while waiting for the search team to find them if they are immobile. Eventually, trail maps will be produced and made available to

community search and rescue organizations, Village Public Safety Officers, and community residents.

4.3.3 Initial Specifications of the Tripod Design

Trail markers will be installed at maximum intervals of roughly 500 feet. The distance between specific markers will vary with terrain, wind, and soil conditions as determined by the local residents performing the installation. Installers place markers as close as 100 feet where/when terrain and whiteout conditions warrant. Installers place markers at the edge of rivers, lakes, and the coast to alert travelers to ice danger.

Each tripod marker will be made of three pieces of eight foot long wooden round stakes held together with wire (see Figure 4-2). Trail markers will be labeled with an information sign at trail intersections and each leg will be marked with colored reflective tape.

The trail markers are freestanding and movable. It is not the intention of the project to establish or require dedication of easements for the trails marked by these projects.

Routes will be determined by local residents who use the trails. Trail locations will be identified using coordinates from a GPS receiver. At a minimum, coordinates will be taken every fifth stake or major bend in the trail.

Trail markers will be installed during the winter, because many routes are not accessible until the surface is frozen.

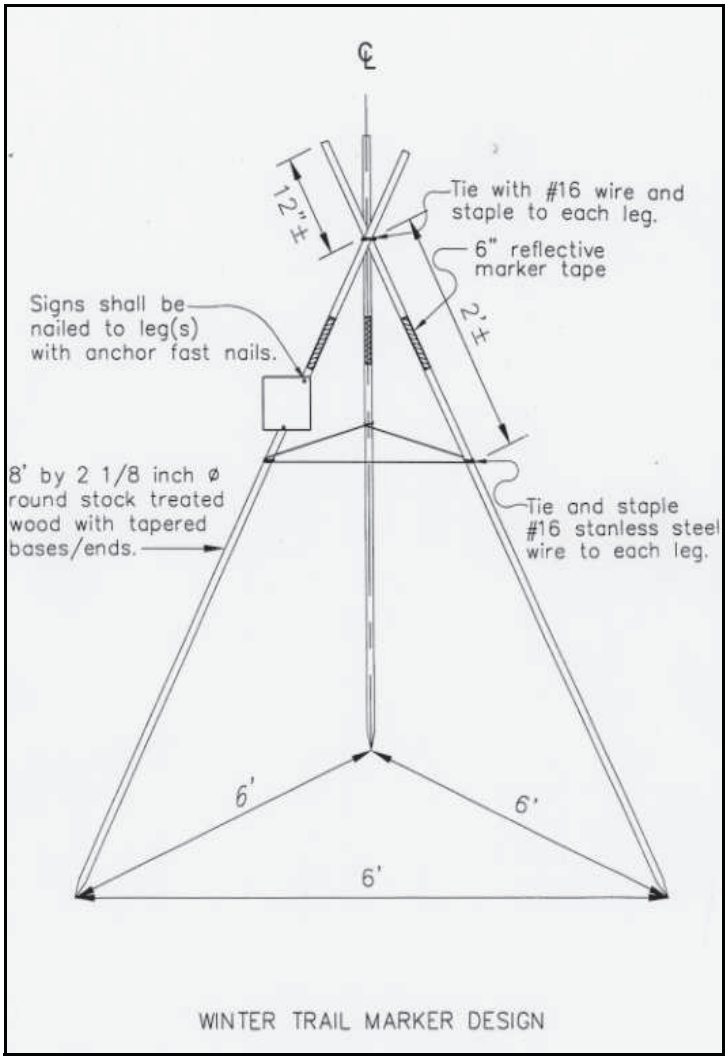


Figure 4-2 Initial Tripod Trail Marker Design

Section 5. Highway and Road Plans

This chapter reports on inter-village road and mineral resource development road analyses examined as part of the Y-K Delta Plan. The analyses were conducted to look for affordable road infrastructure that would provide enhanced travel for villagers, or help the region move toward a stronger, more diverse economy.

A second goal was opportunities to consolidate transportation infrastructure, notably airports, and other public facilities such as schools and health clinics to reduce maintenance and operations costs. Villages that asked DOT&PF to consider roads were, on the other hand, looking for improved overland access without sacrificing other community infrastructure.

5.1 Coastal / Tundra Village Roads

Four inter-village road segments were requested during Y-K Delta Plan development. The roads were examined using cost estimates and construction technique considerations from recent engineering reports for roads in the planning area.

The investigations found that the roads would generally traverse difficult tundra/ permafrost wetlands and involve many stream crossings. Land management issues related to the Yukon Delta National Wildlife Refuge lands further complicate road development. Additionally, while some local material sources can provide subbase material, suitable base-course and finish material would need to be imported.

The cumulative affect of these factors is that roads are exceptionally expensive to build and maintain. The roads are also difficult to keep open in winter compared to airports at each village. Finally, while some people expressed support for proposed roads, many villagers expressed concern that new roads would provide access to village subsistence resources by persons from outside those villages. The investigation found that no inter-village roads were cost effective within the planning timeframe. The results of the analyses are summarized in Table 5-1.

An exception to conditions outlined above is the existing 23-mile road between St. Mary's and Mountain Village. This road, built about 20 years ago, has fallen into disrepair and several sections (constructed in valley locations because of project cost overruns) are prone to snowdrifts that significantly increase maintenance and operations costs. The road needs to be rehabilitated and the valley sections need to be relocated. Both St. Mary's and Mountain Village support rehabilitating the road and have worked with DOT&PF to get it included in the department's capital budget program for 2004 construction.

Table 5-1 New Roads Requested in the Coastal Area of Y-K Delta

City Pair	Distance	Planning Estimate	Advantages	Disadvantages
Bethel to Napakiak (Reconnaissance study done)	12 mi.	$24M	Provides more convenient access to Bethel amenities.	Sufficiently far from Bethel that joint services are not likely. Significant wetland and river construction constraints.
Nunivak Island from North to South	50 mi.	N/A	Access to major fishing grounds on south side of island. Terrain is good for road construction.	Crosses through the middle of National Wildlife Refuge lands, including substantial portions of wilderness area.
Tununak to Toksook Bay	8 mi.	$12 M, based on Napakiak and other road studies.	Reasonable terrain, land owned by the two village corporations, connecting villages of 330 and 500. Possible consolidation of airport facilities, schools, health care, and other services now done separately.	Tununak wants to keep airstrip. No vehicles to use road.
Akiachak to Bethel	14 mi.	$25+M, based on Napakiak study.	Strongly urged by the local village council. Provides access that is more convenient to Bethel.	Sufficiently far that joint service is not likely. Significant wetland and river construction constraints.

5.2 Up-River Road Considerations

In the rolling hills country east of Aniak the soils and terrain are much more amenable to road construction. The planning team looked at two major corridors in this area. One was a connection between the Parks Highway east of the Y-K Delta and the upper Kuskokwim River. The other connection was between the Yukon River and the mining district that lies between the Yukon and Kuskokwim Rivers.

While there has been ongoing discussion of a route east to the Parks Highway, the current judgement is that the long distances, small populations, and limited freight transport opportunities when coupled with difficult environmental impacts precluded further consideration of this route in the 20-year timeframe of the Y-K Delta Transportation Plan.

A smaller-scale project that can assist mining development is the generally north-south route between Ruby on the Yukon River and McGrath on the Kuskokwim River (Figure 5-1). It would transit a significant lode and placer mining district in the western Tintina mineral belt (Figure 5-2).

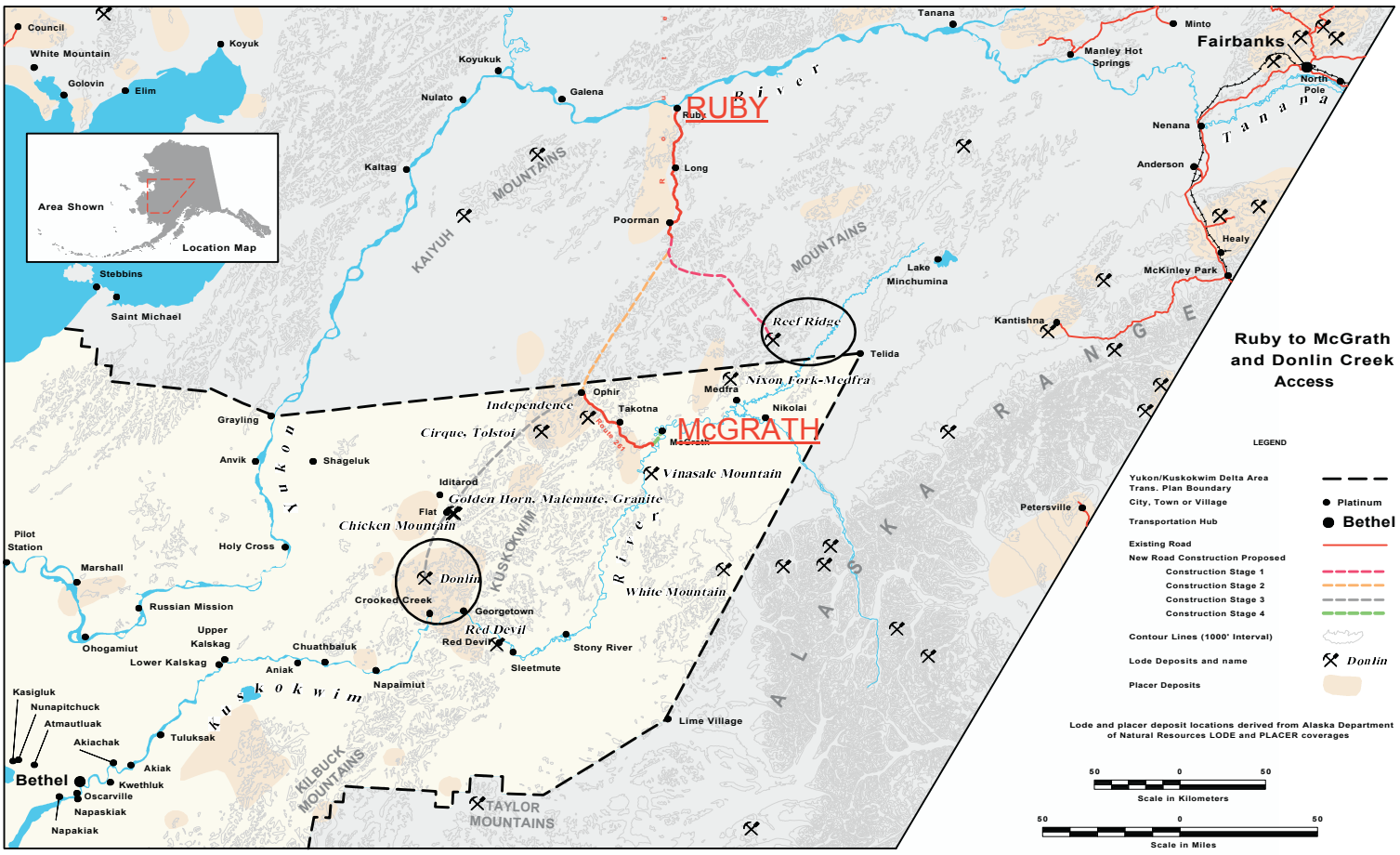


Figure 5-1 Ruby to McGrath Road/ Mining District Known Mineral Deposits

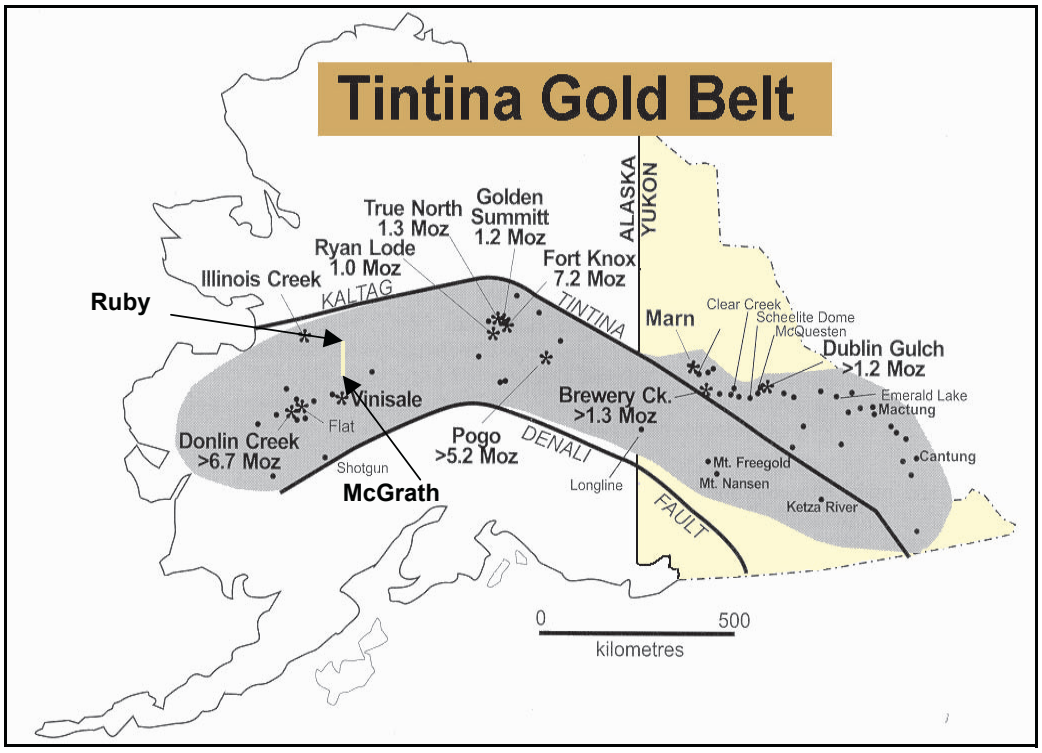


Figure 5-2 Tintina Gold Belt

In Figure 5-1, the light gold patches represent where placer deposits have been discovered. The crossed pick-axes represent known lode deposits. All indications are that the mining claims in the region have strong potential. The mineral areas on the map show a strong correlation with the minerals discovered in the eastern areas of the State and western Canada.

This route would provide a connection to Alaska's urban services and supplies by way of the Yukon River to Fairbanks. A road link from the Yukon River through the mining district was started early in the 20th century, but work was discontinued after World War II.

Two Federal Aid roads exist that would form the north and south segments of the mining district access:

- 53 miles south from Ruby on the Yukon River to Poorman
- 40 miles northwest from Sterling Landing on the Kuskokwim River through Takotna to Ophir

The original road from Sterling Landing to Ophir was a portage to serve miners working along the Innoko River and its tributaries. The current proposal differs from past routes to some extent. The first construction efforts would be to access the two major mineral developments at Reef Ridge and Donlin Creek rather than linking Ruby and McGrath. It is clear from early investigations however, that the eventual routing would connect the two communities.

Villages in the upper Kuskokwim area support development of the mining industry that they state appears feasible if access were provided to the interior transportation systems. Both Calista Corporation and Doyon Limited, the two regional Native Corporations that border each other in the mining district, have major mineral developments in the area.

Equally important, the State of Alaska has selected lands throughout the region specifically for mining development and road access. This is in sharp contrast to most potential overland routes in the State where land selections and land management mandates through federal conservation units make road construction nearly impossible.

The planning team found that mining opportunities benefiting from access would help diversify the Y-K Delta regional economy and develop a local workforce. Local workers trained to build the road would then be available to the mining industry that would use the road connection to the Yukon River.

The circled pick-axes represent the Donlin Creek gold deposit and the Reef Ridge zinc deposit. The first generation of access to the mining district is likely to be to the Reef Ridge Zinc deposit south and east of Ruby. Donlin Creek mine owners are using Kuskokwim River barges between Bethel and Crooked Creek for their first generation of mine development, but see access to the Yukon River as beneficial to the full development of the mine.

The road also allows potential development of a coal-fired power plant to operate near McGrath or Donlin Creek. Coal may be supplied from a nearby source, or from arctic coal barged to Bethel and then to Donlin Creek. Power transmission lines to mines and communities in the area may be practical over time.

Equally important over time, access to the major mineral deposits at Reef Ridge and Donlin Creek provides access to the district's placer areas.

Table 5-2 indicates the known mineral deposits. The quantity to be found in a vein or mother lode is unknown, as is the price for extraction, which depends on the purity and mixtures of desired metals with other substances.

Table 5-2 Known Mineral Deposits

Locale	Gold (Au)	Silver (Ag)	Copper (Cu)	Antimony (Sb)	Mercury (Hg)	Tungsten (W)	Bismuth (Bi)	Lead (Pb)	Zinc (Zn)	Thorium (Th)	Tin (Sn)
Chicken Mt.	Au	Ag		Sb	Hg	W					
White Mt.					Hg						
Vinasale Mt.	Au										
Medfra-Nixon	Au	Ag	Cu			W	Bi			Th	Sn
Cirqui-Tolsti		Ag	Cu			W					Sn
Reef Ridge								Pb	Zn		
Independence	Au										
Golden Horn	Au	Ag		Sb	Hg	W					
Red Devil	Au		Sb	Hg							
Donlin Creek	Au										

Source: Alaska Department of Natural Resources Access to Resources

5.3 Transport Alternatives

5.3.1 Rail

The concept of a railroad to facilitate the haul of ore was considered. The three rail options listed are logical routes from a terrain and operational standpoint:

1. Healy to McGrath
2. Berg or Nenana along south bank of the Yukon River to Ruby
3. Ruby along the proposed road alignments to McGrath

However, the scale of ore haul required to make a rail system cost effective is not apparent within the timeframe of the Y-K Delta Plan. Until a number of mines are developed and world market prices make large scale hauling competitive, positive economics of any rail options are not present.

5.3.2 Kuskokwim River

Kuskokwim River mineral transport alternatives will also be examined in the Northwest Alaska Transportation Plan effort. It appears clear though, that river

navigation constraints near McGrath preclude moving resources down the Kuskokwim River to the port at Bethel.

The mid-Kuskokwim River section however, from Crooked Creek to Bethel, is handling medium size tows (40 x 160 feet with a draft of 6 to 8 feet) that support Donlin Creek in its first development efforts. This could not support the other mining developments in the area that would access the Kuskokwim through Sterling Landing and Takotna. Upriver of Crooked Creek, there are shallow spots that make the river impractical for regular mining operation support. The U.S. Army Corps of Engineers (USACE)[1] found that barge service is impeded by at least three major upriver navigation problems:

1. **Lisky's Crossing.** (Milepost [MP] 350-355). This is a particularly difficult section of the river. Although on a reach portion of the river, the bed is so shallow that it is the source of major complaint.
2. **Three Hole Crossing.** (MP 345) Like Lisky's Crossing, it is on a reach portion of the river. It is not as shallow and therefore not as difficult as Lisky's, but it is a navigation hazard.
3. **Medicine Man Crossing.** (MP 325) Unlike the other two shallow depth areas, this crossing occurs at a tight river bend. It is located just out of Stony River.

To operate on this section of the river, the small barges that provide fuel and deck freight to villages take special measures to navigate. At each village, barges must be positioned as close as possible to the riverbank where the depth of the river is adequate to accommodate the barge. This is often some distance from the village.

Each barge also carries a small skiff as part of its load. When dangerous parts of the river are approached, the skiff is launched and a channel is located and marked. In addition, barge operators often must remain moored until water depth becomes sufficient for traversing. It takes 4 to 6 hours to mark the channel and then anywhere from 8 to 12 hours and sometimes days before adequate water depth occurs to allow the barges upriver.

To sustain a high level of traffic, especially from a principal outlet at Sterling Landing, the Kuskokwim River would require a 6- to 7-foot channel so that a fleet of shallow draft vessels could be operated. Only in this configuration could the mining district realize benefits from a Kuskokwim River route.

Figure 5-3 Oxbow on Kuskokwim River between Red Devil and Sleetmute (DOT&PF)

Creating a channel would involve dredging at least the three shallow spots on a continual basis. While USACE suggested other alternatives, such as side channels

1. U.S. Army Corps of Engineers, *Expedited Reconnaissance Report and GIS Database - Kuskokwim River*, September 1997.

(canals), shipping only when the water is high enough, and/or the use of hovercraft to ply the river, their primary alternative was deepening the known trouble spots. USACE found this solution impractical.

The Kuskokwim River is unable to provide the necessary transport capacity for the commerce expected from a sizable mining effort in the region.

5.4 Road/Barge System

The most practical alternative seems to be a road that provides access to the mining district from the Yukon River. It would provide access to the Railbelt and provide flexible, easy-to-construct access to a multitude of mineral deposits off a mainline corridor. Equally important, segments of the route are constructed and the remaining alignments would traverse unrestricted land owned by the State of Alaska. The road would be a mining road at least for its first generation of development. This allows Special Purpose Road Classification standards that would keep initial construction costs lower than costs for a full-standard rural highway.

In 1993, the City of Ruby funded a road feasibility study that evaluated three highway corridors between Ruby and McGrath. The entire study is included in this plan as Appendix G. It provides an excellent overview of the potential alignments that would connect the Yukon and Kuskokwim Rivers.

- The first 53-mile segment of the road (Federal Aid System Highway #271) begins on the Yukon River and ends at Poorman or its nearby mining village of Placerville. Going south from Ruby (MP 0,[2] elevation 200 feet) the road climbs, connecting a series of drainage branches to Hub Hill (MP 16, elevation 1,200 feet).

  Following the 1,000-foot contour, the road then reaches Long Creek (MP 31) and descends to Monument Creek (MP 36, elevation 400 feet) where the crossing is currently impassable.

  From the other bank of Monument Creek, the road continues on the 400-foot elevation to the Susulatna Crossing (MP 42) and climbs for the remaining 12 miles to Poorman (MP 53.5, elevation 700 feet).

- The study provides three alternate routes from Poorman/Placerville to Ophir: the Innoko Corridor at 87.5 miles; the Susulatna Corridor at 90 miles; and the Folger Corridor at 73.1 miles (Table 5-3).

- At Ophir, the new highway would link up with an existing 40.7-mile road (Federal Aid System Highway #261) to Sterling Landing. This section consists of two segments—Ophir to Takotna and Takotna to Sterling Landing on the Kuskokwim River.

  The original road from Ophir to Takotna began as a wagon trail. It

2. The mileposts and elevations are approximate.

served about 100 miners and formed an important portage between the Kuskokwim and Innoko Rivers. A 25-mile wagon road served as an alternate winter route. It was built in 1922 and was maintained until 1929. Today, small mining operations use the road between Sterling Landing and Ophir to transport heavy equipment and fuel.

The segment from Takotna to Sterling Landing serves as an intermodal connection between Takotna and the Kuskokwim River and is under consideration by DOT&PF for a rehabilitation project in the near-term. This portion also passes through the Tatalina Air Force Base, located about midway between the Kuskokwim River and Takotna.

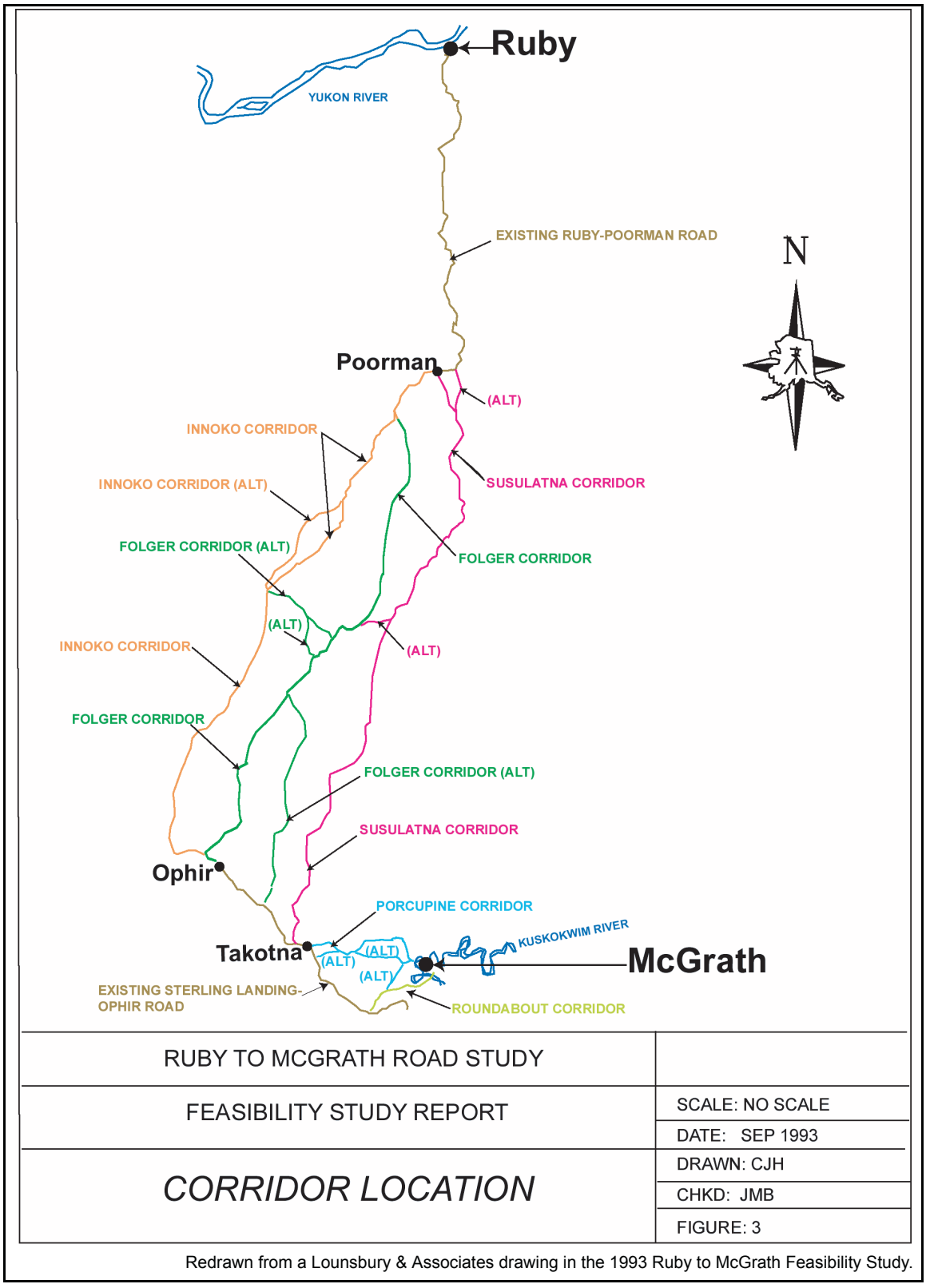
- A road section would also be needed to connect Takotna with McGrath. Figure 5-4 shows the corridors suggested in the feasibility study.

  The Porcupine Corridor, about 19 miles long, requires a Kuskokwim River crossing into McGrath. This route runs along the winter trail currently used between Takotna and McGrath.

  A second alignment, called the Roundabout Corridor, would branch off the existing road at Candle Creek, remain on higher ground as it traversed around the base of Roundabout Mountain, and reach the Kuskokwim River almost due south McGrath. It is another two miles to McGrath. This route is longer, but involves less new road construction.

Table 5-3 Possible Corridor Alignments from Poorman to Ophir

Corridor Name	Length	Description
Innoko Corridor	87 miles	A winter-only trail with a gently rising slope paralleling the Innoko River for about 20 miles, crossing the river twice. Called the lowland corridor since it traverses an area with numerous water bodies and muskeg areas resulting in curves to avoid unstable soil.
Susulatna Corridor	92 miles	Follows a rolling to mountainous alignment providing the most direct route to Takotna. It is 300 to 500 feet above the Innoko drainage. While there are a number of “cat trails” along the ridgelines, any new road will require alignment with complex vertical and horizontal curves increasing the construction cost. It follows the Susulatna River basin trail for about 20 miles and then veers to the south to about 2000 feet and then on into Takotna at 1000 feet.
Folger Corridor	74 miles	Uses one of the oldest trails in the region. It lies between the Susulatna and the Innoko corridors, works its way along a set of plateaus, and traverses several low spots. The terrain is rolling to mountainous although the road elevation seldom reaches 1000 feet. It begins at Placerville and follows mainly a summer trail.
		Source: 1993 Ruby to McGrath Feasibility Study



Redrawn from a Lounsbury & Associates drawing in the 1993 Ruby to McGrath Feasibility Study.

Figure 5-4 Possible Alignments for Ruby to McGrath Road

The Ruby Feasibility Study assumes an inter-community connection that provides mineral district access. DOT&PF, in its initial investigations, has found that a route to Reef Ridge and Donlin Creek Mine are the major resource connections needed to justify a road, with community access an eventual secondary purpose of the route. The development of major mineral deposits in this district will provide the base for secondary mineral developments and community connections.

All early indications point to continued study and development of a mining route from the Yukon River transportation system to the mineral district. It appears the project would allow mining operators to begin to realize the potential of the region.

A road between the Yukon River and the communities in the upper Kuskokwim River region may allow Fairbanks-based fuel and freight operators to deliver products to communities at lower prices. Currently navigation difficulties on the upper Kuskokwim River make barge operations from Bethel difficult, unpredictable, and consequently expensive.

The economic development opportunities an active district would provide to the region, especially in light of the economic downturn from the recent commercial salmon fishing collapse, are significant. The people of the area are very interested in having the road corridor developed.

5.4.1 Further Study Required

DOT&PF assigned this project to the Northwest Area Transportation Plan, currently underway. This planning effort involves study of resource transportation corridors throughout Northwest Alaska and now includes the Ruby to McGrath Access Corridor.

The proposal meets the land use and public support tests of modern highway development, it coincides with and offers a springboard for the evolution of the region's economy, and it provides significant opportunities to improve shipping and transportation for the area's communities. The Northwest Alaska Transportation Plan Benefit/Cost Analysis will investigate these principles in detail sufficient to illustrate the timing and scope of mineral resource development that might come from opening this region to Yukon River access.

Section 6. River and Coastal Navigation

6.1 Introduction

Navigation improvements, harbors, and ports remain critical to the economic well being and quality of life for a majority of Alaskans. More than 90% of Alaska's population live within 10 miles of a major navigable waterway and over 95% of all goods arrive in Alaska through waterborne commerce.[1] Virtually all villages in the study area are on the coast or immediately adjacent to one of the two major river systems.

Each section of this plan has focused on a different mode of transportation. DOT&PF has assessed the demand or need for services provided by the mode and to the extent possible, assessed the capital improvements needed to meet existing and projected demand. To the extent that funding is available, demand for infrastructure improvements can generally be met over time. Airfield improvements and winter trail marking, for example, both have funding sources available for improvements to infrastructure.

The marine mode presented in this section is different. A large catalog of marine needs was developed during the planning process, but there are few funding sources available to address the needs.

The U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard (USCG), DOT&PF, and the region's barge operators recognize the needs. People in the villages have also raised navigation issues in most public meetings. Almost every village would benefit from mooring buoys or beach anchors (deadmen) for barges to assist fuel and freight transfer.

Many port and harbor and maritime needs have also been identified. At present, there are few funding avenues for addressing those needs, although barge operation improvements may be incorporated into an aggressive tank farm rehabilitation program funded by the Denali Commission.

Figure 6-1 Mountain Village (DCED)

1. Alaska DOT&PF, *Sustaining and Developing Alaska's Ports and Harbors: A Statewide Proposal*, "Executive Summary," 1991, page 1.

6.1.1 Description of the System

There is likely no other region of the United States that is so underdeveloped and hostile to marine delivery of fuels, cargo, building materials, and heavy equipment. Aids to navigation, clearly defined approaches, channels, and harbor limits are foreign to this region. Vessel movements along the coast or on the rivers are totally dependent on local knowledge and excellent seamanship.

The State's role in marine facility development has waned in recent decades leaving this region in western Alaska under-developed when compared with other regions of the State.

With few exceptions, landing facilities at the villages are unimproved riverbank or coastal sites. Many river landing sites vary from year to year and sometimes by season, depending on water level and sand bar movement. Other needs include charting, navigation aids, weather forecasting, protected harbors (especially for small boats), and selective channel dredging.

Today, in addition to more fuel and freight tonnage moving on the water, over 8 percent of the population hold commercial fishing permits, and the new Community Development Quota (CDQ) programs have made halibut and pollock quotas available to many coastal communities. In several cases, these resources are under-utilized because docks and harbors restrict boat size.

It is well recognized by operators, communities, and agencies that the deficiencies of port and harbor facilities are inherent in the:

- Geography of the region
- Location of communities on rivers, sloughs, and shallow water coastline
- Small population
- Low cargo volumes
- Seasonal access
- Ice movement
- Relatively weak cash economy

Issues that argue for improvements to the marine transportation system include fuel barge spill risks, the high cost of freight and fuel, and economic development opportunities.

Figure 6-2 Yukon River (DOT&PF)

6.1.2 State Role in Harbor Development

Nearly $500 million has been appropriated for navigation improvements by the State in the 40 years since statehood. No community in the Y-K Delta, except Bethel, has been able to secure substantial State investment in marine

transportation infrastructure. The $13 million spent in this region has been mostly for erosion control projects.[2]

Figure 6-3 Kasigluk, Village Separated by a River (DCED)

Expansion of Alaska's ports and harbors infrastructure is important and requires sound investment strategies by the public sector. Currently, the State participates with city and borough governments and USACE in feasibility studies, construction of navigation improvement projects, and necessary port and harbor improvements.

Navigation improvements eligible for USACE investment are generally limited to channel dredging and breakwaters at 65–80% federal cost depending on depth of improvements. Local sponsors are responsible for all costs associated with other service facilities needed to make the project viable including inner basin structures. DOT&PF assists a community or borough with the federal process, including support for legislative requests for approximately 50% of non-federal costs. The local sponsor uses other federal and local funds for the balance of development costs. Projects that do not have substantial local financial support are often not successful in competing for State funds.

State policy requires local operation and maintenance of ports and harbors. Small boat harbor projects were often constructed directly by the department to be operated and maintained by the community. DOT&PF currently owns 76 public port and harbor facilities in the State.[3] Fifty-one are operated through formal agreements with local governments, 25 harbors of refuge are maintained by the department, and 22 harbor facilities, previously owned by the State, are now under local ownership.

Figure 6-4 Quinhagak Dock (DOT&PF)

2. Compiled list of projects for water and harbor facilities, 1960-1999.
3. *Inventory and Status of State Port and Harbor Facilities*, Alaska Department of Transportation and Public Facilities, 1999.

6.2 Reconnaissance of Navigation

Conditions in the Y-K Delta are extreme by any comparison with normal maritime operations. Non-ice summer shipping seasons are short, distances are long, coastal waters are shallow, navigation aids are few, and facilities are non-existent. Sandbars near shore and in bays and rivers created by waves and currents are constantly changing.

Figure 6-5 Bethel Dock (DOT&PF)

Beach landings are the norm both in river and coastal cargo transfer operations. Bethel, and to a lesser extent St. Mary's, are exceptions. The Port of Bethel tonnage has gone from 44,000 tons in 1991 to over 184,000 tons in 1997. The trend is for increased tonnage each year. The facility has a sheet pile cell bulkhead wharf for cargo and fuel handling, with water depths to –14 feet mean lower low water (MLLW) datum. St. Mary's on the lower Yukon River also has a small dock and small boat harbor.

6.2.1 General Navigation

Approaches to the region are south from the Gulf of Alaska around the end of the Alaskan Peninsula, a journey of approximately 1,100 nautical miles from Anchorage or 1,800 miles from the Pacific Northwest. The other major route is east across the North Pacific from Asia to the Bering Sea.

Each approach to the Y-K Delta and the Yukon and Kuskokwim Rivers is unique; partial excerpts from the United States Coast Pilot [4] (*in italics*) offer a flavor of the difficulty in navigating these waters.

Kuskokwim Bay to Bethel

(275) A vessel that draws 15-feet is the deepest draft vessel that should attempt to reach Bethel.

(273) Cape Newenham. In S weather a heavy sea and tide rips occur off Cape Newenham. Satisfactory anchorage for south or east weather can be had in about 8 fathoms off the small cove on the north side of the cape and about 3.5 miles from it's outer end.

275) Security Cove, 9 miles ENE of Cape Newenham, is a good anchorage except with NW winds; the usual summer gales are SE. The bottom is even and shoals gradually. The best anchorage is 3.5 fathoms, mud bottom, is about 0.8-mile NE of Castle Rock and on the range of Castle Rock and the first promontory southwest. There is good anchorage in two fathoms with good holding ground in

4. *United States Coast Pilot*, 19th Edition, Volume 9, *Pacific and Arctic Coasts Alaska: Cape Spencer to Beaufort Sea*, page 308.

the middle of the bight on the SW side of Castle Rock. This anchorage is less affected by the groundswell making along the coast from Cape Newenham than anchorage in Security Cove.

280) Goodnews Bay is shoal except for the channel with depths ranging from 1.25 fathoms to 12 fathoms that leads through the entrance to a point about one mile inside. This channel affords good anchorage, either in the middle of the entrance or up to 0.8 mile inside the bay on a line approximately NE of the S tangent of North Spit.

A pilot boat from Goodnews Bay precedes some commercial traffic into the Kuskokwim River system. The 40-mile approach through Eek Channel to the Kuskokwim River is a maze of shifting sandbars and blind channels. The channels in the bay undergo constant change from year to year because of the action of the sea, river currents, and ice; extreme caution and continuous soundings are necessary. A seasonally maintained, basic buoy system marks the run through Kuskokwim Bay and up the river to Bethel. There are no shoreside or extended season markers for small boat navigation. In the late fall, river depths at Johnson Bar (at the Oscarville crossing, about six miles downriver from Bethel) can reach depths below 14 feet and must be avoided. [5]

Bethel to McGrath

(314) Bethel, 65 miles up the Kuskokwim River, is considered the head of ocean navigation.[6] From here riverboats, operate to points on the upper river.

(331) It is reported that extensive changes have taken place N of 59 36'N. The Chart is no longer a sufficient guide with respect to the channels.

Shallow depths in the upper reaches of the Kuskokwim River, particularly in an area between the villages of Stony River and Sterling Landing, impede navigation. Three locations identified by vessel operators and by previous USACE studies present frequent problems.[7] These crossings, near Stony River and Sterling Landing, are known locally as Three-Hole, Medicine Man, and Lisky's Crossings.

To navigate these shallow areas, operators commonly break tow and maneuver the crossings with only one barge. In many cases, the cargo has to be redistributed to provide a shallower draft. Once all the barges are across, the tow is then reconnected and travel resumes. Service to communities and mining operations upriver of the shallows is unpredictable and fuel in particular often is flown in at high per gallon rates.

Yukon Delta

(532) The Yukon River delta extends about 90 miles from Black River, 40 miles NE by N from Cape Romanzof, to Apoon Pass. The river discharges by many mouths through the delta. Bars at the entrances have little depth, and the channels through the flats are narrow, crooked and bordered by shoals that are

5. U.S. Army Corps of Engineers, *Yukon-Kuskokwim Delta Coast Regional Port Study*, January 2001.
6. *US Coast Pilot*, page 310.
7. U.S. Army Corps of Engineers, *Expedited Reconnaissance Report and GIS Database, Kuskokwim River*, Alaska District, 1997, page 4.

exposed at low water. They are also subject to constant change. Apoon Pass is the entrance used by the riverboats.

(541) Kwikluak Pass, which empties into the Bering Sea along the N side of the islands that separate it from Kwemeluk Pass, is the main S mouth of the Yukon River. Approaches to Kwikluak Pass are generally very shallow. Accurate soundings are not available due to shifting shoals near the entrance.

(546) Pastol Bay, at the NE extremity of the Yukon Delta is about 25 miles wide between the delta and on the W and Point Romanof on the E and has general depths of 1-6 feet.

(547) Apoon Pass, at the head of Pastol Bay, is the principle approach to the Yukon River from St. Michael. In common with the rest of the region, the surrounding country is only 1-2 feet above high water.

(549) The approach to Apoon Pass is across unmarked shallow flats. A seasonal light marks the entrance to the pass. Because depths are only 1-2 feet, all but the shallowest draft vessels must cross the flats at high or near high water.

Fuel and freight bound for lower river villages comes downriver from Fairbanks and Nenana, while St. Michael provides fuel and freight to the local coastal communities, including Emmonak and Hooper Bay.

During the Klondike Gold Rush, Congress authorized two projects to open the Yukon River to coastal vessels. One project would have dredged a channel 150 feet wide, to –6 feet below MLLW through the Apoon mouth of the Yukon River.[8] The other project was a channel 250 to 300 feet wide and not less than 2 ½ feet deep through the bar at Pastol Bay. Congress recommended abandonment[9] in 1925 because the Klondike Gold Rush was waning.[10]

Saint Michael Bay

(584) Saint Michael being the end of deep-water navigation, all the Yukon traffic beyond this point has to be conducted with vessels drawing 5 feet or less. The larger launches leaving St. Michael Bay go around the N side of St. Michael Island and through Stephens Pass, between St. Michael and Stuart Islands. They give wide berth to the reef off Rock Point, on the N side of St. Michael Island, and, after passing between the islands, make a straight course slightly W of Point Romanof. When the summit of Point Romanof is abeam, about 1.5 miles, the direction is changed and a course is steered for Apoon Pass. The most dangerous part of the passage is the 14 miles around the N end of St. Michael Island, which is exposed to the deepwater swell from the N. This can be avoided by small craft by going through St. Michael Canal.

Authorized by the same citations as the Apoon Mouth project, the St. Michael Canal project provided for dredging a channel 100 feet wide to a depth of 6 feet below MLLW. The project extends from St. Michael Bay through the canal for a

8. House Document 1932, 64th Congress, 1st session.
9. Document 467, 69th Congress, 1st session.
10. U.S. Army Corps of Engineers, *1998 Project Maps & Index Sheets,* pages 1-2.

distance of 6¼ miles, with widening of the channel at two sharp bends. This project was also de-authorized in 1925.[11]

Nunivak Island

Nunivak Island, approximately 70 miles long and 50 miles wide, lies 20 miles off the coast west of Toksook Bay. Mekoryuk is the primary advocate for a sub regional port for the region's coastal communities. USACE has studied the potential of a regional port and concluded that the economics of the region do not warrant it at this time.[12]

Some entries in the United States Coast Pilot for the island are:

(421) Chart 16006. – Nunivak Island, in the Bering Sea near the Alaska mainland, is about 330 miles from Unimak Pass. Dangerous shoals and uneven bottom have been reported and are shown on the chart; the island should be approached with extreme caution.

(424) In 1899 the U.S.S. Corwin cruised completely around Nunivak Island, following the shore and outlying islands at a distance of about 2 miles, and found general depths of 7-10 fathoms. The coast is generally abrupt and rocky, with numerous bights in which anchorage was found in 3½ to 7 fathoms.

Each community on the coast, all served by lightering barges and small tug or tow vessels, have unique approaches and underwater conditions and profiles. Annual and seasonal changes and near-shore conditions from wave and ice action make approaches and landings especially precarious. There are no harbor charts or navigation aids to assist approaches to a community. There are no protected basins offering shelter in inclement weather. Barge operators are cautious and patient, or aggressive as appropriate, to safely discharge or embark cargo along the coast.

6.2.2 Weather and Ice Forecasts

Weather forecasts are essential to safe navigation. The coastal region has three forecast areas covered by the National Weather Service (NWS) Alaska forecast office.

- Area 8, Cape Newenham to Dall Point covers approximately 214 nautical miles of coast including Kuskokwim Bay, Nunivak Island, and north to Hooper Bay.
- Area 9A is from Nunaktuk Island at the lower mouth of the Yukon River to Sledge Island in Norton Sound west of Nome, a distance of approximately 95 nautical miles to the north.
- Area 9B, is from Dall Point to Wales (approximately 245 nautical miles to the north) and includes the Saint Lawrence Island waters (approximately 120 nautical miles to the west of St. Michael). Area 9B covers the study area from near Hooper Bay to St. Michael. Because of the expanse of these area forecasts, intermediate locations interpolation is necessary.

11. Ibid., page 1-37
12. USACE, *Regional Port Study.*

Sea ice advisories by the NWS for western and arctic coastal waters become critical as the ice is retreating at the beginning of the season and as it moves into the region at the end of the shipping season. During the coastal navigating season, sea ice edge location is the major controlling factor. The probability (in percent) of the ice edge location in the lower reaches of Kuskokwim Bay is 100% in March and retreats to 0% probability by June 15.[13] However, annual weather conditions can affect the edge condition of ice and exceed all expectations in either direction in any given year. In most years, edge ice has retreated from the area above St. Michael Bay by July 1.

Taken together, these critical but limited services improve the safety and productivity of the waterway by helping shipping companies and fishers avoid unproductive and dangerous conditions.

6.2.3 Tides and Currents

Tides in the region are both diurnal (one high and one low per lunar day) and semi-diurnal (two high and two low tides per lunar day), depending on location. Tides from Apoon Mouth north are diurnal. Daily predictions are influenced by weather systems on and off shore. Storm surge depends on characteristics of the storm and the bathymetry of the area. Shallow bodies of water generally experience higher values. Coastal Alaska can experience storm surges over 13 feet.

St. Michael (Station 2409) provides regional tide information for stations from Apoon Pass to Nome. Nushagak Bay (Station 2353) near Clarks Point in Bristol Bay provides information for the southern portion of the coast. The seventeen intermediate stations are produced by adjustments of time and height to the two stations mentioned above (see Table 6-1).

6.3 Vessel Operations in the Region

6.3.1 Freighters and Tankers

Freighters and tankers are infrequent silhouettes on the horizon west and north of Dutch Harbor. Bethel, the only reporting port facility in 1997, reported only five inbound passenger or dry cargo self-propelled vessels.

Tugs and barges are the primary means of fuel and cargo movements in the region. In 1997, 230 inbound trips, comprised of 95 tug or tow, 125 non-self-propelled dry cargo vessels, and five non-self-propelled tanker vessels, were reported in Bethel. The total of all Bethel trips, inbound and outbound, was 435 line-haul barges.[14]

13. Arctic Environmental Information and Data Center, *Alaska Marine Ice Atlas*, University of Alaska, 1983.
14. U.S. Army Corps of Engineers, *Water Resources Support Center, Waterborne Commerce of the United States*, Part 4, *Waterways and Harbors*, “Pacific Coast, Alaska, and Hawaii, Calendar Year 1997”, Alaska District, page 205.

Table 6-1 Tidal Stations in the Region

Station	ID	Lat. (North)	Long. (West)	Mean Range (feet)	MHHW (feet)	Mean Tides (feet)
Goodnews Bay	2359	59-03	161-49	6.2	8.9	3.7
Carter Spit	2361	59-19	161-57	8.0	10.7	4.7
Eek Channel	2363	59-45	162-15	9.7	12.3	5.3
Wharehouse Creek entrance	2365	59-56	162-05	10.0	12.6	5.5
Kuskokwak Creek entrance	2367	62-02	162-10	9.6	12.2	5.3
Popokamute	2369	60-04	162-25	8.3	10.9	4.6
Apokak Creek entrance	2371	60-08	161-10	9.4	12.0	5.2
Bethel	2373	60-48	161-45	2.3	4.0	1.5
Tachikuga, Nunivak Is.	2393	60-04	167-14	3.1	4.3	2.3
Kokechik Bay	2395	61-42	166-00	4.8	6.5	3.4
Cape Romanzof	2397	61-49	166-05	5.2	6.8	3.3
Black, Black River	2399	62-20	165-19	3.8	5.0	2.5
Kwiklauk Pass, Yukon River	2401	62-37	164-51	1.4	2.3	0.8
Kawanak Pass entrance, Yukon River	2403	63-02	164-28	1.5	2.7	0.9
Apoon Mouth, Yukon River	2405	63-03	163-23	—	4.0	2.0
Pikmiktakik River entrance	2407	63-16	162-36	—	4.2	2.1
St. Michael (Harmonic Station)	2409	63-29	162-02	—	3.9	2.0
North Bay, Stuart Island	2411	63-37	162-30	—	2.8	1.4
Compiled from data found on Tides and Currents Nautical Software, Inc.						

Cargo movements analysis of general cargo movements shows:[15]

- General cargo is moved to and within the region by mainline, coastal, and river barges by a single common carrier, a number of contract waterborne carriers, and by air.
- Air shipments are primarily through the USPS Bypass Mail Program that could account for about 50% of the total general freight shipments.
- Lightering barges that transfer cargo from ocean barges that anchor in Goodnews Bay provide common carrier barge to coastal villages.

15. USACE, *Regional Port Study,* page i.

- Large volumes of general cargo required for major construction projects are typically transported by contract barges and delivered directly to the village where the construction project is located, typically with the assistance of one or more lightering barges.

Estimates of annual shipments of general cargo to coastal villages range from 10 to 1,000 tons each, depending on the village and the basis of the estimate. Substantial cargo transfers occur at the mouth of the Kuskokwim River for river barge delivery to communities and villages in the region. Understandably, the majority of cargo, 72,553 tons, is reported to have gone to the Port of Bethel in 1995. Dry goods, fuels and oils, and raw materials shipped from Bethel the same year are reported to be 66,544 tons.

Comparison of Bypass mail rates and barge rates for general cargo shows that the rate for Bypass mail is less than one-half the barge rate. This is due to USPS Bypass mail subsidies. Analysis of the barge rates (costs) indicates that the rates are primarily a function of local conditions (mooring and unloading) rather than distance. Thus, the benefits would be larger for improving local conditions than for reducing transportation distances through the development of a new regional port.

Analysis of fuel movements shows:[16]

- A single waterborne carrier transports essentially all of the fuel that is delivered to the region.
- Yukon River villages, including those near the coast, are served from Nenana.
- Coastal villages are served by lightering barges operating from an ocean barge anchored near Eek Island.
- River barges that operate from Bethel serve Kuskokwim River villages.
- Regional storage facilities are located at Bethel and St. Michael. Fuel stored at a Bethel tank farm with a total capacity of about 9.4 million gallons is used to supply communities from Eek to the mouth of the Kuskokwim River at Nikolai. The fuel stored at the St. Michael tank farm (estimated capacity of 1.3 million gallons) is used to supply the Yukon River and Norton Sound communities.

6.3.2 Hovercraft

Cargo movement by hovercraft (on an operational basis) has begun from Bethel to the nearby villages of Akiachak, Akiak, Kasigluk, Kwethluk, Napakiak, Napaskiak, and Nunapachuk. Although used mainly for the movement of USPS fourth-class mail, the hovercraft also carries regular cargo and on occasion passengers. It is estimated that the hovercraft moved over 2,000 tons of fourth-class mail in 1999.

6.3.3 Lighters, Push Boats, and Utility Boats

Since line-haul barges can only get into two communities (Bethel and St. Michael), fuel deliveries made to all but these two communities are made with lightering barges that have drafts of not more than

16. Ibid.

4 feet. Yutana Barge Lines, a Northland Company, owns and operates all six lightering barges. Three of these make deliveries to the coastal villages while the others make deliveries to communities on the Kuskokwim and Yukon Rivers. Approximately 28 percent of the fuel shipments are lightered directly to final destination villages from the ocean barge (the smaller Yukon Fuels barge). During direct lightering operation, the ocean barge typically anchors on the lee side of Eek Island in the mouth of the Kuskokwim River. The lightering barges then load from the ocean barge and deliver to the communities from Goodnews Bay to Scammon Bay. During times when the water level in the Kuskokwim is too low for the larger line-haul barges to get into Bethel fully loaded (14-foot draft), the lightering barges will load from those as well to lighten the load until they can cross Johnson Bar.

For operational reasons, Yukon Fuels/ Yutana Barge does not mix “blue and brown water” equipment. This means that all the coastal communities are served by a set of three lightering barges that operate on the ocean. The Kuskokwim and Yukon River communities are served by a set of three lightering barges that operate on the rivers. Approximately 22 million gallons of fuel enter the region.

Figure 6-6 Lightering Barge and Tug (DCED)

6.3.4 Personal Watercraft

Several thousand outboard-powered skiffs essential to community transportation operate while the waterways are free of ice. Over 2,000 individuals have commercial fishing permits. These people all use small boats and skiffs. Skiff travel is also essential for individual and family life for subsistence, social, and commercial purposes.

6.4 Shore Facilities

6.4.1 Coastal Facilities

Throughout the region, coastal facilities are generally beachhead-landing sites. Along the coast, barges equipped with ramps move to connect to shore on incoming tides in near still-water conditions. Forklifts, front-end loaders, and cranes transport cargo to shore depending on available equipment. This time consuming and ice edge dependent system results in high fuel and freight costs.

Mekoryuk, a small community on Nunivak Island, has a small breakwater constructed by USACE. Boats are allowed to remain on the beach at low tide. The harbor is infilling and needs improvements soon.

Figure 6-7 Pilot Station Small Boat Harbor (DCED)

6.4.2 River Facilities

With the exception of the dock at Bethel, most landing facilities are unimproved riverbank areas. River landing sites can vary from year to year, sometimes by season, depending on water level and sand bar movement.

At each village, barges must be positioned as close as possible to the riverbank. Since water depths vary along the bank, the barges must sometimes locate far from the destination village. After mooring to a deadman (secure mooring point formed by a post anchored on the shore with a cable loop or “eye” for connection) on the bank when available, wet cargo, such as heating fuel, is pumped through flexible hoses into bulk storage facilities in or near the destination village. Dry cargo carried on deck is normally palletized and off-loaded with a forklift that operates down a ramp extended from the barge to a solid point on the river bank.

In some situations, the loaded barges cannot be maneuvered close enough to the bank to allow off-loading. When this occurs, as is common at several upriver villages, the cargo remains on board until the water depth increases enough to allow maneuvering the barges into the riverbank.

The City of Bethel operates a small boat-mooring basin approximately one mile from city center. It has a capacity of approximately sixty boats requiring periodic dredging to maintain the –4-foot basin. This is the only facility in the region specifically designed to protect small watercraft from wind and wave exposure.

Standard practice elsewhere is to store boats on sloughs and creek banks away from wider channels where boat wake and wind-driven waves can pummel and sometimes swamp small vessels. Other facilities are shown in Table 6-2.

6.5 System Development

Marine transport happens in the region despite the tough conditions. It is well recognized by operators, communities, and agencies that many of the deficiencies in marine transport infrastructure are inherent in the geography of the region and short operating season.

Nevertheless, the environmental risk of a fuel barge spill, the cost of delivered freight, the steady population growth in the region, and improved quality of life of the residents are issues that argue for improvements to the marine transportation system.

Table 6-2 Existing Marine Transportation Facilities

Community	Facility Description
Chevak	Barge Landing
Hooper Bay	Commercial Dock
Mekoryuk	Breakwater and inter-tidal basin.
Quinhagak	Dock and harbor
Toksook Bay	Boat haul-out services
Bethel	Commercial and public docks, small boats harbor.
Eek	Dock
McGrath	Launching ramp
Nunapitchuk	Dock, small boat harbor, seaplane base on Johnson River

Compiled from Community Information Summary
Refer to Appendix H.

The Yukon-Kuskokwim Delta Coast Regional Port Study[17] discussed the need for a coastal port, but did not support a regional port; rather, the study confirmed the need for improvement at each community. Their report states:

- "There is insufficient volume of waterborne general cargo and fuel to justify the cost of developing a regional port. Furthermore, use of a regional port for the transfer of general cargo and fuel from ocean barges to coastal villages would increase the cost of these deliveries because of handling and moorage costs that would be imposed at the port.
- Analysis of barge rates for a sampling of 18 of the 50 villages in the study area shows the difference in barge transportation costs (rates) *among the villages are largely determined by local conditions rather than distance* [*emphasis added*].
- Development of a regional port at Nunivak Island for the purpose of exporting rock and gravel cannot be justified because there are adequate resources at other locations within the study area that can meet all the potential future needs of these resources at the same or lower costs.
- As much as one-half of all general-purpose cargo is diverted from barge carriers to air transportation because of the U.S. Postal Service's Bypass Mail Program.
- Airport expansion will have no effect on the volume of air- and barge-transported general cargo.
- Analysis of the NED [*National Economic Development*] benefits

17. USACE, *Regional Port Study*, page ii.

shows that there are no significant quantifiable benefits that would be realized by constructing a regional port."

Analysis of the navigation problems shows that there is a need for the following improvements in the region:

- Dredging the Kuskokwim River at the Oscarville crossing (Johnson Bar) to reduce delays and the need for light loading of mainline general cargo and fuel barges and sand, gravel, and rock barges. Shippers indicated that the channel would need to be deepened by about three feet for a distance of about one-half mile to obtain a channel depth of 15 feet during low water conditions that occur late in the shipping season.
- Development of minimum mooring and unloading facilities for river (lightering) barges at all coastal, Kuskokwim River, and Yukon River villages.[18]

The Community Development Quota (CDQ) program is a major new fisheries development program administered in the Y-K Delta by the Coastal Villages Regional Fund (CVRF) in the Kuskokwim River area and the Yukon Delta Fisheries Development Association (YDFDA) in the Yukon River area. They are becoming major economic development engines in the region that potentially need marine transport improvement to achieve commercial success.

6.6 Opportunities for Improvements

Implementation of port and harbor improvements will involve DOT&PF and other capital project agencies. Other agencies have responsibility for important areas that need attention, including:

- Charted waters
- Navigation aids
- Weather forecasting
- Protected harbors, especially for small boats
- Selective channel dredging
- Barge docking facilities and hovercraft landing areas
- Docking access and transfer roads
- Cargo handling
- Fuel handling

In addition, erosion along shorelines and riverbanks is a common problem and erosion management and control is difficult to maintain in the delta area. Throughout the Y-K Delta, erosion has often had a negative impact on transportation. Where erosion threatens the operation of existing facilities, such as an airfield, bank control or relocation options need to be explored.

18. This supports the conclusion of the USACE *Regional Port Study*; see Footnote 12.

6.6.1 Charted Waters

The National Oceanic and Atmospheric Administration (NOAA), responsible for promoting safe navigation primarily to prevent maritime accidents, recognizes that accurate hydrographic information is essential for safe navigation.

NOAA estimates that 43,200 square nautical miles of the U.S. coastline is in critical need of modern hydrographic surveys and that more than half of those waters—23,800 square nautical miles—are in Alaska.[19] Charting in the Y-K Delta region is notably sparse in areas of near-shore navigation. Chart No. 16300, Goodnews Bay, contains a note that the date of survey is 1911. Kuskokwim Bay, the most transited bay in the region is partially charted in the lower reaches, but is lacking any sounding above 59°53' N. The upper reaches of the Bay and the entire length of the river have no sounding or notations.

Charts in the region are updated periodically to add, delete, or modify information. The edition and print dates shown in Table 6-3 indicate charting activity that would update and improve the information to navigators. For example, Chart 16304, the approach to Bethel through Kuskokwim Bay and the Kuskokwim River, is a relatively new chart. The first edition was printed in 1993 as a preliminary chart with Loran C overprint; however, no hydrographic soundings are available.

Table 6-3 Nautical Charts

Chart No.	Chart Name	Edition	Print Date
16006	Bering Sea, Eastern Part	32nd	8/28/98
16240	Cape Romanzof	9th	3/27/93
16300	Kuskokwim Bay	8th	3/10/90
16304	Kuskokwim River, Kuskokwim Bay to Bethel	1st (Preliminary)	5/15/93
16305	Cape Newenham and Hagemeister Strait	9th	3/27/93

When shipping/barging companies were asked by USACE what improvements should be made in the region, water depth, navigation aids, and vessel traffic management were suggested.[20] Updated soundings using modern equipment and methods to establish existing conditions in the Bay and main river channels would greatly improve the safety and reduce the risk of grounding. The USCG, DOT&PF, and marine pilots have influence on how areas are prioritized for the scheduling of surveys. NOAA also takes into consideration survey requests from commercial vessel companies, the public, and the age of the last hydrographic survey.

19. Office of Coastal Survey Workshop, "Navigating Alaskan Waters Into the 21st Century, Meeting Summary and Action Items," Anchorage, Alaska, October 17, 1996.
20. U.S. Army Corps of Engineers, *Reconnaissance of Navigation Improvements, Western and Arctic Coasts*, Alaska District, December 1997.

Approaches to the Yukon River and Kuskokwim Bay are contained in the NOAA critical area list, but no schedule has been set for the necessary field survey work.

6.6.2 Navigation Aids

There are few navigation aids in the region; those that are lighted depend on solar energy for power. During public meetings for this plan, many fisherman and boaters on the lower Kuskokwim River requested fixed navigation aids be set to mark the tributaries off the Kuskokwim that led to villages. They noted several advantages to this approach to navigation assistance, including aiding low light navigation during early and late season travel. The USCG, only recently made aware of this proposal, has no schedule for such markers but will consider them as capital projects, which will be ranked and prioritized in the future.

6.6.3 Weather Forecasting

The NWS, responsible for weather information products and services, can modify forecast products in response to a local condition and need, especially where safety and operational efficiency can be demonstrated. During this planning effort, no improvements were requested, but the NWS is updating systems including the completion of eleven weather stations in the region with real time observations available by telephone. The Alaska Weather Observation Stations indicated in Table 6-4 provide current wind direction, speed and gust velocity, temperature, visibility, ceiling, and barometric pressure. While current conditions are useful for marine operations, *accurate forecasting is also essential.*

The FAA Alaskan Region Capstone program, an automated flight recording/ reporting system, includes automated weather observation stations (AWOS) that enhance current weather knowledge in the area. By 2001, facilities at Kipnuk, Platinum, Scammon Bay, Holy Cross, Kalskag, Mountain Village, Russian Mission, St. Michael, and Kongiganak were online. These added sites provide significant improvements for assessing current conditions, enabling barge and other vessel operators to anticipate conditions along their routes and at their destinations.

6.6.4 Protected Harbors

The key element of improving transport along the region's coast and rivers is the port and/or harbor where people and goods move from water to land and where vessels are safely accommodated. Mekoryuk and Bethel have protected harbors. The region's other communities use the most protected area available for skiff storage.

In the river system, protected basins become less critical because of short reaches in the river, though wind-driven waves moving upriver can be formidable.

Table 6-4 Alaska Weather Stations in the Region

Station	Identifier	Frequency	Type	Agency	Auto #
Aniak	PANI	124.3	AWOS	FAA	675-4282
Anvik	PANV	135.45	AWOS	FAA	663-6353
Bethel	PABE	ATIS	WSO/LAWRS	NWS/FAA	543-5475
Cape Newenham	PAEH	—	AWOS	AF	552-9419x229
Cape Romanzof	PACZ	—	AWOS	AF	552-2869x229
Emmonak	PAEM	135.35	AWOS	FAA	949-1014
Hooper Bay	PAHP	135.1	AWOS	FAA	758-4211
McGrath	PAMC	135.65	WSO	NWS	524-3850
Mekoryuk	PAMY	123.90	AWOS	FAA	827-8513
Quinhagak	PAQH	134.8	AWOS	FAA	692-5900
St. Mary's	PASM	128.8	AWOS	FAA	438-2135

Compiled from Alaska Weather Station Identifier List (http://www.alaska.net/~nwsar/station-identifiers.html)

Figure 6-8 Toksook Bay (DCED)

Wind-driven waves and river traffic can cause considerable damage to barges and skiffs along the shoreline, but there are few opportunities for improved skiff storage along the region's river corridors. Nevertheless, even in naturally quiet waters, major improvements to riverbanks for mooring skiffs can make these activities safer and reduce equipment damage to improve the cost and the quality of life in the village.

6.6.5 Selective Channel Dredging

While most of coastal Alaska abounds with deep-water bays and sounds, the Y-K region is a riverine delta, complex with extensive shallows and shifting channels and bars. Water depths for entrance channels, maneuvering basins, and moorage constrain vessel traffic. Beach slopes are very gradual with the 60-foot contour 20 to 40 miles offshore in most areas. The water movement of these two large glacial-fed rivers brings with it considerable forces that cause shifting river bottoms and depths.

Though somewhat arbitrary, three depth-descriptive adjectives are used to define port capacity. Shallow, medium, and deep

draft ports are generally defined as those with less than 20 feet of water, less than 35 feet of water, and greater than 35 feet, respectively. Water depth, if not occurring naturally, is a costly feature to create. Bethel is the only coastal or river port in the Y-K region that is capable of handling ocean-going barges. On high tide, it may satisfy the medium draft criteria, but it is functionally a shallow draft port.

Further evaluation of coastal commerce and pursuit of federal and state policy that can assist marine infrastructure development in the region were requested during this planning effort. Quinhagak, for instance, would benefit from a dredging project that would make all-tide docking operations available for the transfer of fish products for their processing plant and air transport services.

6.6.6 Barge Docking Facilities and Hovercraft Landing Areas

Landings, the common way to handle barges in the Y-K Delta, are a segment of beach or riverbank adjacent to a community. Landings may be graded, but in most cases, very little improvements exist. Fuel is usually delivered by hauling hoses up the beach to storage tank headers, or to the tanks themselves.

Many improvements to river facilities, including barge anchoring systems and developed riverbank landings, were requested during the plan's public meetings. Most villages and the region's barge operators stated that even minimal improvements would significantly aid transfer of fuel and freight from barges to the villages.

USACE, the agency that constructs federally funded breakwaters, jetties, and entrance channels, is required to use stringent national economic development (NED) criteria that prove a project has a federal interest and a positive benefit-to-cost ratio. Throughout western and northern Alaska, where commodity volume is low, cargo value moderate, shipping is seasonal, and development and maintenance costs high, the existing criteria preclude any federal assistance to the basic navigation improvements in the region.

The dichotomy of need and program requirements in federal policy is clearly illustrated in the 1997 USACE Western and Arctic Coast Navigation Improvements Study.[21] The report states:

- Every community in the study needs improved barge access and loading facilities for the delivery of fuel and cargo.[22] Another common need is a safe means of launching, retrieving, and storing boats.
- None of the projects in the five communities that volunteered local sponsorship show immediate prospects of positive benefit-to-cost ratio, which is needed for a recommendation for a detailed feasibility study.
- This is probably also true for the other 10 projects, though economic benefits were not estimated. This is

21. Ibid.
22. USACE, *Regional Port Study*.

so even though the community need for each of these projects appears to be well founded.

This is a major area for improvement. A few facilities have been constructed, but most villages in the region have had little or no improvement. Construction of village landings, as outlined in the capital project portion of the section, would have significant effect on improved fuel and freight handling. They are important basic improvements that can be rapidly constructed with local labor and in some cases, local equipment. To execute these improvements other funding sources will need to be developed.

Eight villages near Bethel are receiving mail and cargo on a regular basis by hovercraft. While the hovercraft can operate on either water or land, it is presently prohibited from inland operation on the wildlife refuge surrounding Bethel. It is allowed only on the State rivers. In future operations, properly designed docking pads would serve both the hovercraft and barges, which would improve freight handling and condition.

6.6.7 Docking Access and Transfer Roads

Transfer point access is also important for villages. The place where barges can safely dock may be some distance away from the village and access is necessary to permit people to move from vessel to other transport to the end destination. This usually means climbing out of skiffs, manually handling goods into and out of the skiffs, and physically carrying gear, freight, and/or subsistence/commercial fish up and down irregular ground between the waters to a vehicle, if any. Four wheelers, and in some cases trucks and vans are available, but in many villages, the goods are often manually transported from the waterfront to the destination.

Every community in the region has access to a runway, but in most communities, the tie between waterborne activity and air transportation is not efficient. Where fish or other products are shipped out of the region by barge or air, the lack of available community services (such as poor roads, lack of trucking capability and cold storage) can become a significant cost factor. Landings can significantly aid and promote economic development. Moving fish or any other product between modes efficiently directly affects the economic viability of the product.

6.6.8 Cargo Handling Equipment

Cargo is usually delivered to the beach or riverbank by the barge line. Each site is unique depending on the customer and local capability. In many cases, barge companies carry the load directly to the end customer with the same piece of equipment to move the freight. While this is a service to the customer, it is also very costly to a transportation company; the barge, tug, and other crew are operating inefficiently or on standby while waiting for equipment to make the round trip.

Barge operators and village leaders have stated front-end loaders and other resident handling equipment would significantly improve service to villages and improve freight capacity on the barges.

6.6.9 Liquid Fuel Handling Equipment

Given the enormous costs of upgrading and/or increasing the amount of fuel storage capacity, the issue of air delivery of fuel was examined. Supplying fuel by air on a scheduled basis reduces storage capacity needs; savings in tank farm capacity may result in cost-savings to villages, as they would be able to pay for smaller loads of fuel more easily.

The review found that summer and early fall delivery of fuel by barge was the most cost effective in all cases, yet there are cases where barge delivery is unacceptably unpredictable or difficult. In those cases, DOT&PF has committed to airports that will accommodate the most cost-effective, airborne delivery that is practical for those upriver sites, including Takotna, Nikolai, and Lime Village.

6.7 Implementation

Capital projects outlined in the sections above would reduce delivery costs, increase frequency of service, improve the value of regionally exported products, reduce damage loss and environmental risk, and improve the productivity, safety and quality of life for people in the region. Yet there is no predictable stream of funding that can be translated into a program of projects. The plan is able to point to deficiencies and recommend a direction of desired outcome but is limited in its ability to provide a timeline for development of specific projects. A discussion of the funding situation is presented at the end of this section.

6.7.1 Riverine Village Barge Landing Plan

A simple, low cost system of deadmen and buoys would improve barge delivery to many villages. Ultimately improvements that are more substantial might be appropriate for some villages as they grow and the freight delivery requirements grow. A sample Transportation Improvement Plan for undeveloped waterfronts is presented in Table 6-5.

Marine transportation improvement opportunities could occur through construction of other projects. There are major construction projects planned for most community airports, and there are plans for several road projects. Schools, Native Corporations, and/or resource exploration companies are also planning developments in the region. In each major construction activity, there is the need to move large amounts of heavy equipment and building materials to construction sites. A practical and meaningful way to obtain some of the marine improvements needed in the region is to preserve the barge landings and access roads built to handle the transfer of those materials and equipment.

This would need to be done in each village consistent with community plans, and to protect the environment, cultural, and social values, but the opportunities appear practical. A community can gain benefits by creatively influencing after-project conditions from these non-marine projects.

6.7.2 Active Projects or Village Requests

In addition to the simple landings and barge mooring improvements, other projects have been identified through the department's Statewide Need and Priorities List and the recent reconnaissance study by USACE. These are presented in Table 6-6. These projects will be investigated as part of the department's ongoing work with the communities and USACE.

6.8 Project Funding

6.8.1 Federal

Federal funding for water transportation has evolved since the first congressional authorization that vested responsibility with the Army (General Survey Act, 1824). Navigation improvements are federal projects that may be requested by a local sponsor. Once found to satisfy national economic criterion, USACE becomes the advocate, and where the local sponsor can provide the 20-35% non-federal match funds, approved projects are constructed and maintained by the federal agency. The local sponsor is required to construct all the necessary service facilities without federal assistance.

Table 6-5 Improvement Plan for Undeveloped Waterfront

Project	Purpose	Timing	Cost Range
Install deadmen	Define landing site. Permanent mooring points that reduce operating cost through efficient use of equipment.	Near-term	Low
Small boat deadmen	Provide secure on-bank tie-up points for small watercraft.	Near-term	Low
Mooring buoys	Provide secure in-river tie-up points for watercraft of all kinds.	Near-term	Low .
Fuel header improvements	Reduced spill risk through controlled access, containment measures, and proper design.	Near-term	Low to Moderate
Construct bulkhead	Standard equipment can move freight safely and efficiently from barge to shoreside. Reduce risk of fuel spill. Improve safety of freight transfer.	Mid-term	Moderate to High; potential dredging needs
Dredge basin	Sufficient to float barge at all water levels. Reduce barge grounding; reduce risk of fuel spill.	Long-term	Moderate to High; potentially high annual costs
Surface cargo area	Provides for efficient use of mobile equipment by appropriate equipment selection, lower equipment and site maintenance cost.	Mid-term	Moderate

Table 6-5 Improvement Plan for Undeveloped Waterfront (continued)

Project	Purpose	Timing	Cost Range
Construct covered storage sheds	Cargo security by providing protection from elements, controlled access, and reduced pilferage.	Mid-term	Moderate to High; depending on features
Small boat float	Provide floating dock for safe access and secure moorage of small boats reducing boat and motor damage from grounding and obstructions.	Mid-term	Moderate
Small boat launching ramps	Defines site that provides safe, efficient, and convenient launching activity reducing impact of this activity in other areas.	Mid-term	Moderate; also subject to river dynamics that can add high annual costs

Table 6-6 Projects Identified

Community	Project	Project Description
Aniak	DOT&PF 4912	Feasibility study for dock and harbor facility improvement.
Chefornak	DOT&PF 2254	A barge landing access road would improve access to the barge landing from the airport access road.
Kongiganak	Dredging	The village has requested the U.S. Army Corps of Engineers dredge the Kongiganak River channel in two locations. One 400-foot section is located upriver near the village and is needed for fuel barges. The lower 1.5-mile section is near the mouth of the river. Barge traffic must navigate at high tides only. The river depth shallows further during dry weather, which limits runoff and can make navigation difficult even during high tides.
Napaskiak	Dredging	Recent reconnaissance report identified areas with shallow drafts at high and low tide. Residents stated it is common for fishers to have to wait for high tides to navigate even skiffs into the village. Barge navigation is likewise tidal-dependent on twice a year service. Napaskiak was also the subject of a 1973 reconnaissance report. The problem statement was to maintain navigational access to the village. A description from the 1973 report says, “The village is fronted by tidal flats which have practically choked off access to Napaskiak and Napaskiak Slough to anything but small skiffs used for personal transportation. It was reported that even those could not pass from slough to river at low tide.” The dredging option would likely require annual or frequent channel dredging to maintain project depth.
	Dock	Dock construction was suggested as an option to build road access to a deeper site facing the Kuskokwim River across an island immediately in front of town at the mouth of Napaskiak Slough. The project would consist of a bridge, new road, and sheet pile dock. The dredging option would have potential federal interest if economic feasibility could be determined. The dock option has no components of federal interest.

Table 6-6 Projects Identified (continued)

Community	Project	Project Description
Nightmute	Obstacle Removal	Remove obstacles to navigation (boulders) in the Toksook River near Nightmute.
Mekoryuk	Breakwater and Port	Construct a breakwater and port facility for the import and transshipment of freight and fuel, export of minerals, fish landings, and to offer other port services.
Mountain Village	DOT&PF 6795	Construct a 20- x 40-foot small boat dock.

Federal (USACE) interest in navigation improvements requires a solution that includes channel dredging or breakwater protection. Demonstrated economic justification by a feasibility study to show a positive net benefit to the nation, independent of local and regional benefits that might accrue, is required. NED criteria is satisfied if the project is technically possible, economically justified, and environmentally and socially acceptable. A benefit-cost analysis is undertaken to ensure that the value of the outputs exceeds the value of the inputs. A project's environmental and social viability is also determined by an analysis of biological, cultural, historical, and social impacts. USACE and the U.S. Congress scrutinize navigation improvement projects in Alaska before authorization. Federal appropriations are for projects named by line item or are included in discretionary program authorization.

The federal program process is expensive, time consuming, and complex, but when complete, it can result in substantial federal investments in Alaska's infrastructure needs and a commitment for continued maintenance. However, as the Statewide Needs and Priorities List shows, many of Alaska's needs cannot be met with this federal program. In addition, as stated in other sections of this plan, the needs and geography of this region and the sparse population make satisfying the federal criteria a nearly impossible threshold to cross. Established in statute, the NED criterion limits opportunities for federal investment in this region.

Notwithstanding the difficult threshold of satisfying NED, the cost of a USACE feasibility study is between $600,000 and $900,000. It would be a rare occasion that any river or coastal village could afford the 50% match, or with State assistance 25% match, even if the benefit could be found to satisfy national needs. Existing laws and policies limit both the federal and state investments in this region.

Another mechanism, not yet fully engaged in transportation projects, is the Denali Commission. The Commission is responsible for coordinating public resources to solve the immense infrastructure needs of the rural regions of the State. As the Commission identifies its work plans in the future, communities will present the positive impacts waterborne commerce can have on the cost of living and quality of life in villages. It is possible the Denali Commission may focus some of its attention on shoreside marine transportation improvements.

6.8.2 State Programs

Through 1974 and 1976 Port and Harbor Development Bonds and other legislative general fund appropriations, the State has helped coastal communities reduce transportation costs by constructing port and dock projects for cargo, fuel, freight, and passengers. These port facilities serve commercial carriers, either barge or container ship; very large commercial fishing vessels; and other transient utility vessels.

State assistance was most often through municipal grants administered by the Department of Administration or DOT&PF through Transfer of Responsibility Agreements. Many of these projects also contained elements funded by the Economic Development Administration, a federal program for economic development.

In addition to helping communities with USACE programs, the department provides half (50%) of the non-federal costs. The State is able to leverage significant benefits at a low State investment, typically 10% to 30% of the total project costs. These ratios make port and harbor projects comparable to other federally funded transportation projects.

In extenuating circumstances, DOT&PF may fund 100% of the non-federal costs. However, local government must provide all right-of-way, lands, and easements and is responsible for the completed project without additional State financial assistance.

Other agencies and entities are also contributors to projects on occasion. For example, the USACE Regional Port Study was funded partially by the Coastal Villages Resource Fund, a CDQ group interested in port development to make their fisheries more productive. They were able to provide $25,000 (25% share) of the $100,000 planning task.

In most parts of the State, the first private investments on the waterfront directly relate to receiving fish and selling fuel. Freight eventually takes a foothold. Continued economic expansion will tend to come if business objectives can be satisfied. Over time, as communities grow, the ability to meet program criteria for port and harbor improvements will become more solid, resulting in needed projects coming on line for the Y-K Delta.

Yukon-Kuskokwim Delta

Transportation Plan

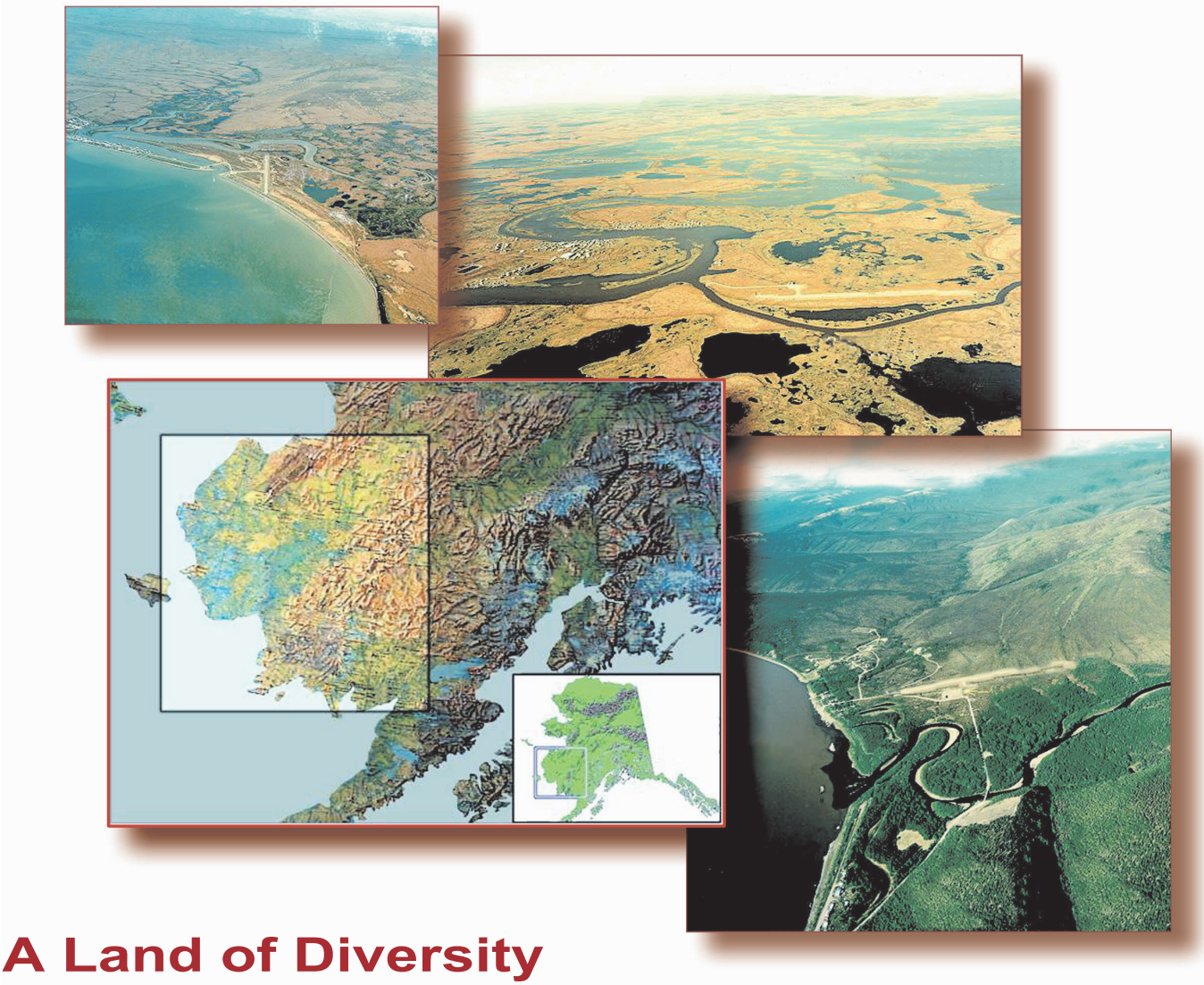
Summary

An Element of the
Alaska Statewide Transportation Plan

Alaska Department of Transportation
and Public Facilities
March 2002

Contents

Yukon-Kuskokwim Delta Region



A Land of Diversity

Alaska Department of Transportation and Public Facilities
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Mike McKinnon	Headquarters Planning
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David Marshall	David Marshall & Associates
Carol Gibson	Michael Baker, Jr., Inc.

Clockwise from Top Left:

Coastal Village, Tununak (www.alaska.faa.gov/flytoak/data/region.idc; (FAA, Alaska Region)

Tundra Village, Nunapitchuk (FAA, Alaska Region)

Upriver Village, Crooked Creek (FAA Alaska Region)

Regional Map (AK DOT&PF)

Cover:

Bethel Camai Girl (Alaska DCED, Community Database Online, www.dced.state.ak.us/mra/CF_PhotoIndex.cfm; DCED)

March 2002

Yukon-Kuskokwim Delta Transportation Plan Summary

Introduction

Department of Transportation and Public Facilities (DOT&PF) staff and project consultants worked with Yukon–Kuskokwim (Y-K) Delta villages, businesses, and an Advisory Committee of regional leaders over the last three years to analyze the region's transportation networks and determine future demand on the networks. The planning team also examined alternatives to the existing systems, including highway and railroad routes from interior Alaska to Bethel. Small populations in the region and relatively low freight volumes combined with long distances to the state's rail and highway connections and challenging construction conditions to make these alternatives impractical within the Y-K Delta Plan's 20-year horizon.

The goals developed during the planning process are:

- Identify basic transportation projects that improve safety and enhance quality of life for the region's 25,000+ residents
- Identify basic transportation infrastructure needed to support economic development opportunities

The resulting Y-K Delta Transportation Plan (Y-K Delta Plan) describes the region's transportation system, its immediate infrastructure needs, and the capital projects needed to meet future transportation demand and strengthen the region's economy.

This Summary is one of three documents that make up the Y-K Delta Plan. Its purpose is to provide an overview of the plan's findings and conclusions. It serves as a general distribution product for public and DOT&PF staff use. It illustrates the specific aviation, winter trail, and road projects DOT&PF has direct responsibility for and outlines projects brought forward in the planning process that may be pursued by other funding sources.

The other documents are the full text of the plan and a set of appendices that support the plan. The full text details the findings and conclusions presented in the Summary. The plan document also includes detailed information on the region's economy, social structure, and demographics. It explains how population and demographic analysis models and transportation system models used to project demand were developed. The plan presents modal chapters on existing aviation, marine, and overland transport systems and the capital and operating improvements needed to meet projected demand.

The appendices include the full documentation of analyses that were used to prepare the plan. This information is useful for future research on transportation in the Y-K Delta and other rural areas of the state.

Figure 1 Subsistence Activity in Alakanuk (DCED)

Figure 2 Aerial View of Red Devil (FAA, Alaska Region)

Figure 3 Boardwalk in Nunam Iqua (DCED)

Many transportation improvement projects identified in the analysis phase of this plan have been included in the department's State Transportation Improvement Program (STIP) and Airport Improvement Program (AIP). The remaining projects outlined in the plan will be incorporated into capital project programs as funding becomes available.

Figure 4 Transportation in the Y-K Delta (DCED)

About the Region

The land status in the study area is illustrated in Figure 8. National Wildlife Refuge lands and other federal lands cover a very large proportion of the region's coastal and tundra areas. The State of Alaska and the region's Native Corporations are major landowners in the mineral-rich inland areas.

Almost 85% of the 25,000+ (1999 census) Y-K Delta residents are Yup'ik. Over 1,000 Athabaskan join the Yup'ik living in the upper Kuskokwim River villages. The Yup'ik and Athabaskan cultures are some of the oldest, most intact indigenous cultures in the world.

Figure 5 Camai Festival – Dancers (www.bethelarts.com)

The subsistence lifestyle, which includes hunting marine mammals, large game, and birds; collecting eggs; year round fishing; and picking berries is central to the region's economy. People travel to hunting areas and fish camps by skiffs and small boats on rivers and sloughs during the summer. In the winter, they use snow machines, especially for hunting, trapping, and ice fishing.

Within villages, most travel is by all-terrain vehicle (ATV) in the summer and snow machine in the winter. Many coastal and tundra villages use boardwalks over wetlands and soft tundra areas to accommodate ATVs that haul mail, water, sewage, and freight. In the larger villages, cars and trucks are a growing part of the vehicle fleet. Bethel, the region's hub community of 5,499, people has a vehicle fleet similar to most small towns in Alaska.

Figure 6 Quinhagak High School (DCED)

Bethel serves as the economic, commercial, transportation, and social center of the Y-K Delta. It has a modern airport, the region's hospital, and a 12-million gallon fuel storage facility that serves many Kuskokwim River villages. A distribution center and a major shopping center to serve the region are under construction. Depending on winter conditions, many villages near Bethel are linked by ice roads on the frozen rivers.

During the summer, barges bring fuel, construction materials, and large consumer goods to the region. Line-haul barges from Seattle and Anchorage work their way up the Kuskokwim River to Bethel. From Bethel, river barges bring fuel and goods to Kuskokwim River villages.

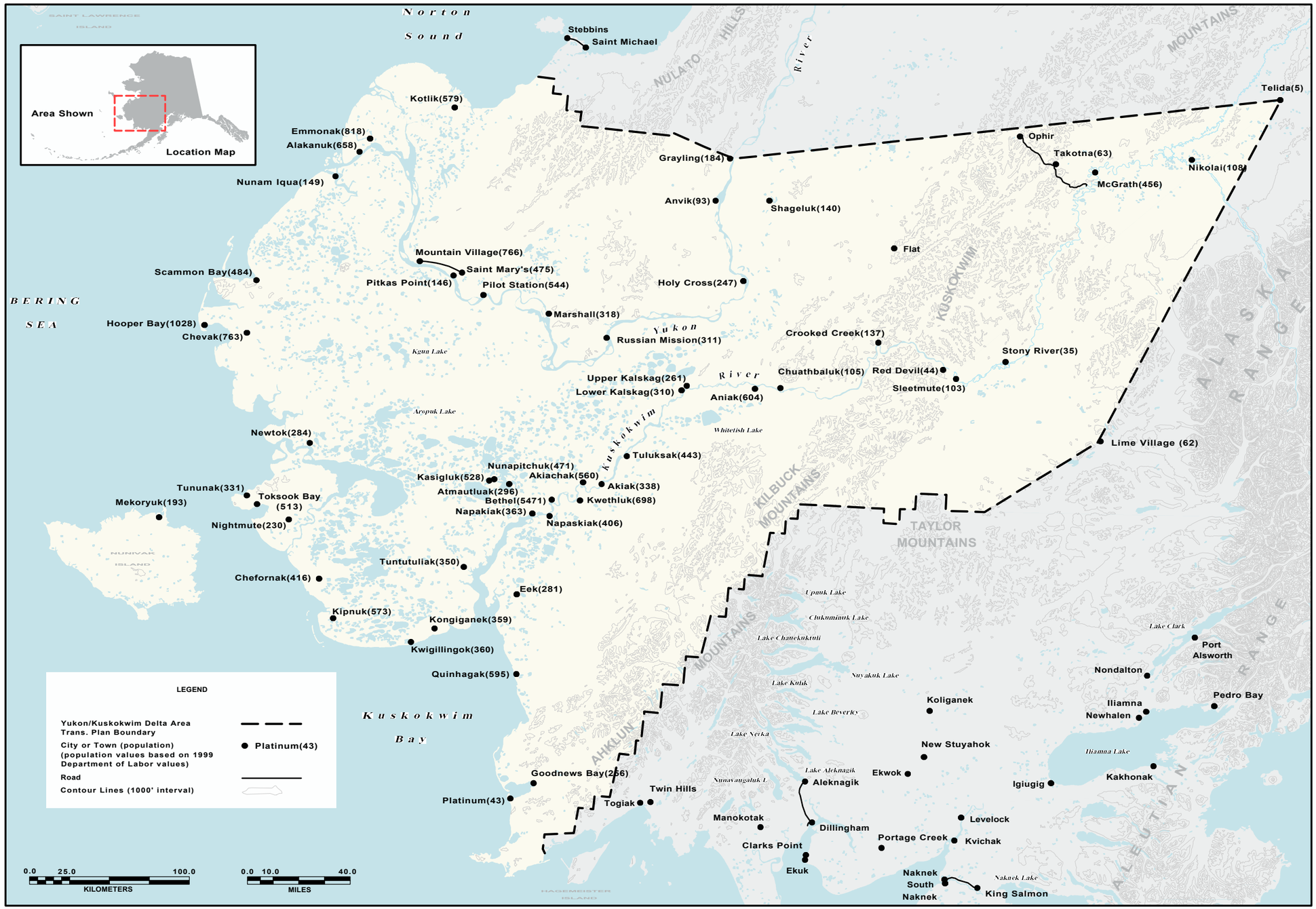

Figure 7 Y-K Delta Study Area

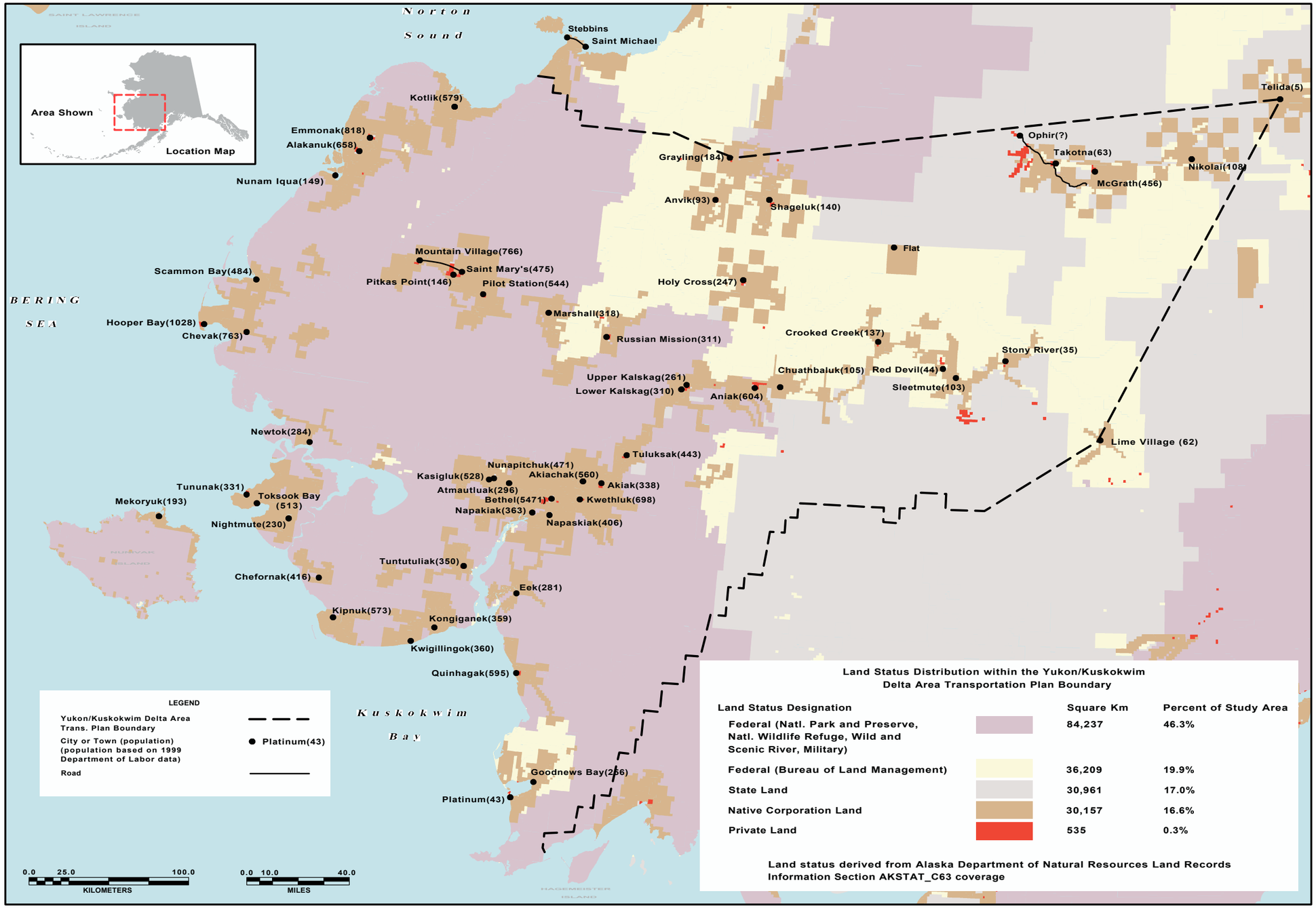

Figure 8 Y-K Delta Land Status

Figure 9 Bethel – Y-K Delta Hub (DCED)

Figure 10 Bethel's First Barge of Summer (DOT&PF)

Figure 11 Lightering Barge (DOT&PF)

Out on the coast, line-haul barges stand off the shallow coastal waters, loading shallow draft lightering barges that transport fuel and goods to individual villages. Line-haul barges also call at St. Michael, which then serves lower Yukon River villages with river barges. Barges from Nenana also supply Yukon River villages.

Bethel-based air carriers serve the 10 villages within 30 miles of Bethel and the 15 villages located along the Bering Sea coast. Over one-half of the 250,000 (1999) air passengers traveling annually in the region are taking trips to and from Bethel.

Smaller air hubs are at Aniak, Emmonak, St.Mary's, and McGrath. Aniak and McGrath serve upriver villages along the Kuskokwim and the midriver villages on the Yukon River from Russian Mission to Grayling. Emmonak and St. Mary's serve the villages along the lower Yukon River and villages as far south as Chevak on the coast.

In 1999, Bypass mail, a United States Postal Service (USPS) aviation-based fourth-class mail distribution system, delivered over 48 million pounds of food and consumer products to Y-K Delta villages. Figure 12 illustrates the system's hub and spoke route structure. Bypass mail is designed for orders of 1,000 pounds or more. Certified distributors in Anchorage combine orders for direct shipment to the region's postal hubs. At hubs, air carriers break down the pallets for transshipment to the smaller villages.

While the Bypass mail system is expensive to operate, it reflects the continuing commitment of the USPS to provide a consistent level of fourth-class mail service throughout the country. USPS efforts to streamline Bypass mail costs statewide include trucking fourth-class mail up the Dalton Highway to a Prudhoe Bay hub, where it is then flown to area villages, and hovercraft service to several villages near Bethel.

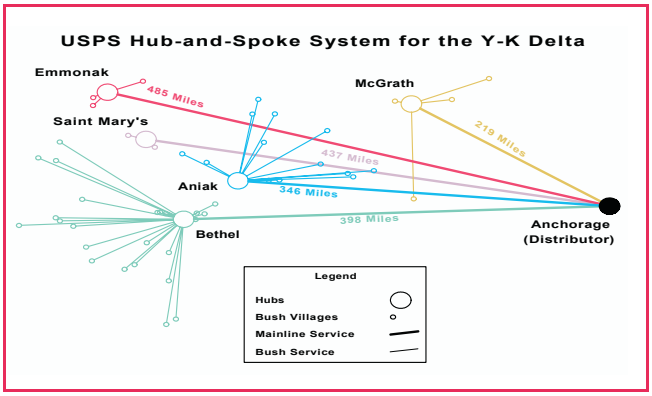

Figure 12 USPS Hub-and-Spoke System for the Y-K Delta

Figure 13 Bypass Mail Preparation at Denali Shippers in Anchorage (DOT&PF)

Figure 14 Bypass Mail Waiting for Transshipment at Emmonak Hub (DOT&PF)

Figure 15 Delivering Bypass Mail in Napakiak (DOT&PF)

Figure 16 Hovercraft Delivering Mail in Napakiak (DOT&PF)

The Focus of the Y-K Delta Plan

After analyzing the Region's transportation needs and opportunities, the planning team developed four major transportation infrastructure improvements that formed the basis of the regional transportation plan for the Y-K Delta.

- ***Airports*** upgraded with runways, lighting, and navigation capability to meet transport demands.
- ***Winter trails*** marking to make snow machine travel safer.
- ***Roads*** to provide the mineral rich upper Kuskokwim River region intermodal access to Yukon River barge operations and the 5,400-foot hub airport at McGrath.
- ***Barge moorings / Landing improvements*** at river villages to facilitate freight handling and fuel transfer.

1. Airports

The distances and challenging terrain between Y-K Delta population centers and the state highway system preclude highway construction as a major transportation strategy. Airport development is the plan's most important transportation issue.

In a region lacking highways, residents travel by plane five times more frequently per person than the national average. Aircraft are also the prime means to deliver goods (mail and cargo) normally delivered by truck in the rest of the country.

Although DOT&PF has committed significant funds to Alaska's rural airports in recent years, the Y-K Delta Plan's aviation system analysis illustrates the need to expedite completion of the region's airport network.

The plan's analysis found that despite progress on improving airports in the region, the smaller airports require single piston-driven engine aircraft like the Cessna 206/207 which are having a difficult time meeting the increasing demand for passenger and Bypass mail/air freight services. Aircraft accident rates have increased in recent years and are now significantly higher than those found throughout the rest of the country. The department's aviation system analyses showed that improved airport runways and runway lighting was urgently needed to improve air carrier operations, especially in the Y-K Delta. This was confirmed during the planning process by efforts undertaken by the Federal Aviation Administration (FAA) National Transportation Safety Board and the private insurance industry.

The FAA has recently initiated an experimental GPS-based air navigation system called "Capstone" that provides flight track recording, aircraft and ground avoidance capabilities, and instrument-grade landing capabilities for small aircraft. FAA chose the Y-K Delta for their initial tests. FAA and the National Weather Service also began working together on an accelerated effort to install sophisticated weather reporting devices for the region to reinforce the onboard "Capstone" equipment.

These improvements and capabilities in turn require that all airports meet basic standards for lower ceiling and approach minimums. It also requires runway-landing lights compatible with the new approach minimums and runway dimensions.

The department's analysis found that most village airports will function well in the short term with the Statewide Aviation Division's new 3,300-foot runway standards. However, modeling of demand and projections about aircraft needed to meet demand show that many airports in the region will need 4,000-foot runways over the next twenty years. Several upper Kuskokwim River villages need 4,000-foot runways now to receive airborne fuel deliveries because barges are unable to consistently and cost-effectively deliver fuel.

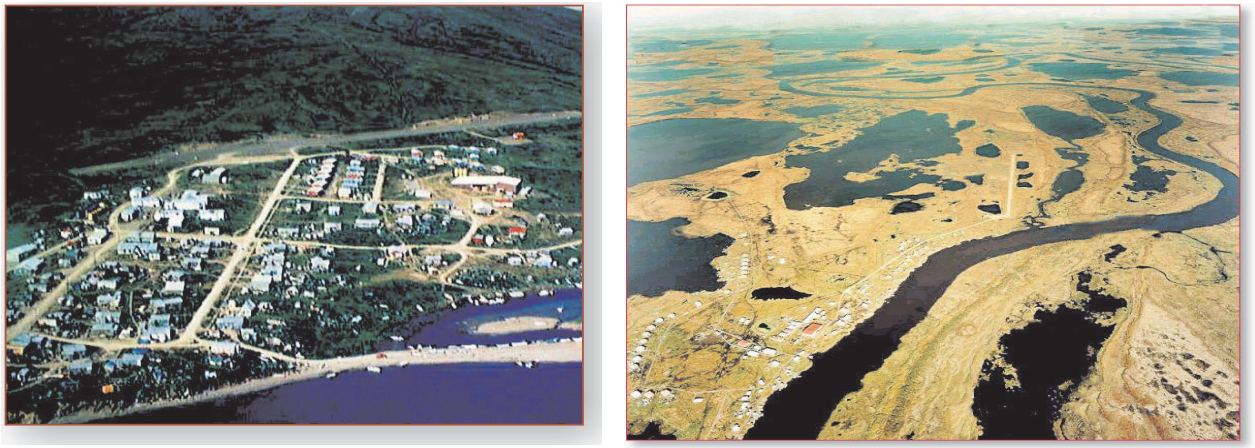

Figure 17 Toksook Bay (Airport in Back (DCED)) and Atmautluak (FAA, Alaska Region)

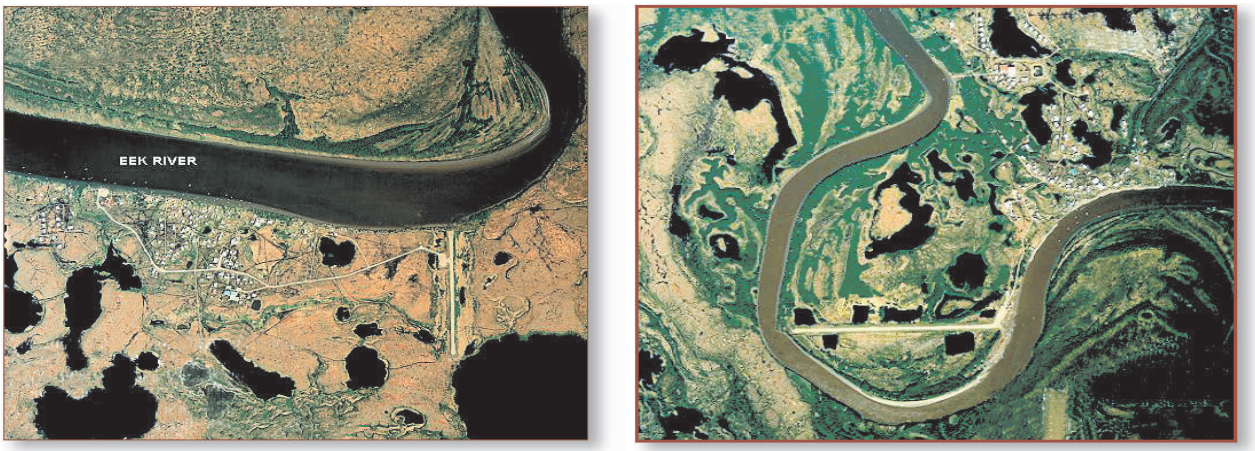

Figure 18 Example of Airports being Relocated – Eek and Tuntutuliak (FAA, Alaska Region)

Cessna 206/207s, DeHavilland Twin Otters, and Piper Navajos currently handle most small village air service. DC-6s, Beech 1900s, CASA 212s, Hercules C-130s, and other freight aircraft handle the large mail, fuel, and cargo loads in the region. The plan's analysis shows that the region's fleet evolution will include single turbine engine aircraft like the new Cessna Caravan and Grand Caravan for smaller villages and those villages close to the region's hubs. The larger villages in the region, and most out on the Bering Sea coast, will need twin turbine engine aircraft that require 4,000-foot runways.

These aircraft will become more readily available as Lower-48 state air carriers continue to move into larger turbine and jet commuter aircraft to meet demand in their markets. The aviation system analysis also found that insurance industry trends, pilot shortages, aviation gas availability, and other pressures are reinforcing the introduction of twin turbine aircraft into rural Alaska. The region's future aircraft fleet will consist of 9-, 19-, and possibly 30-passenger aircraft. DC-6, Beech 1900, CASA 212, Hercules C-130, and Bombardier/DeHavilland Dash 8 class aircraft will continue to bring heavy loads and fuel to the region for many years.

Figure 19 Present Regional Aircraft Fleet
Clockwise from Top Left: Cessna 207; Piper Navajo (Peninsula Airways); Twin Otter (ERA Aviation); DC-6 (Northern Air Cargo)

Figure 20 Emerging Regional Aircraft Fleet
Clockwise from Top Left: Grand Caravan (Peninsula Airways); Beech 1900 (Alaska Cargo Express); CASA 212 (Bering Air); SAAB 340 (Peninsula Airways); Dash-8 (ERA Aviation).

Figure 22 shows runway lengths needed for each village in the region within the plan's 20-year planning horizon. Table 1 (accompanying Figure 22) contains other data recommended for each airport. Projects beyond the 2005 timeframe and projects recommending runway lengths beyond 4,000 feet will be evaluated in individual Airport Layout Plans or Airport Master Plans to ensure that trends and conditions call for the runway dimensions and components predicted by the plan's aviation analysis.

Thirty airports require upgrading to meet state standards, at an estimated cost of $150 million; ten of these projects are already in the construction phase. Seventeen of the region's 53 airports will have to be extended or relocated before 2020 to permit 4,000- to 4,500-foot runways. This cost will likely exceed $140 million.

The plan identifies the need for small airport shelters for people and freight. The State is working with the villages, the Denali Commission,[1] and others to secure funding for shelters. A scenario for shelter construction and maintenance currently under consideration has DOT&PF providing a lease lot to the local community; the Denali Commission or other funding source providing the capital construction funds to the community; and the community then being responsible for the structure's maintenance.

New airports can improve maintenance and operations (M&O) costs over existing airport costs by providing better runway surfaces and better drainage systems that keep moisture from eroding and subsiding runway surfaces and embankments. However, it is also recognized throughout DOT&PF that airport improvements are just as likely to increase M&O costs overall. In the current fiscal environment of budget cuts and increased demand for improved urban services, new rural airport costs put increased pressure on already strained M&O resources.

The planning team tried to quantify the projected M&O cost increases. What it found through conversations with Y-K Delta region airport contractors and maintenance supervisors was that when a new airport is constructed or an airport is extended, contract dollar values for maintaining the airport tend to remain constant. The constant-value contracts seem due in large part to the inability of DOT&PF to increase airport M&O budgets.

M&O costs may also increase if air carriers are successful in extending operating hours at airports to meet increased volumes of Bypass mail and air freight. The department will continue to be faced with significant M&O budget challenges throughout the state as it attempts to focus its attention on its basic statutory mission of inter-community transport.

1. The Denali Commission is a federal government organization developed to assist rural Alaska communities with basic health and transportation capital improvements. The commission is funded through an annual federal budget and is guided in its efforts by a federal-state executive board that oversees operations.

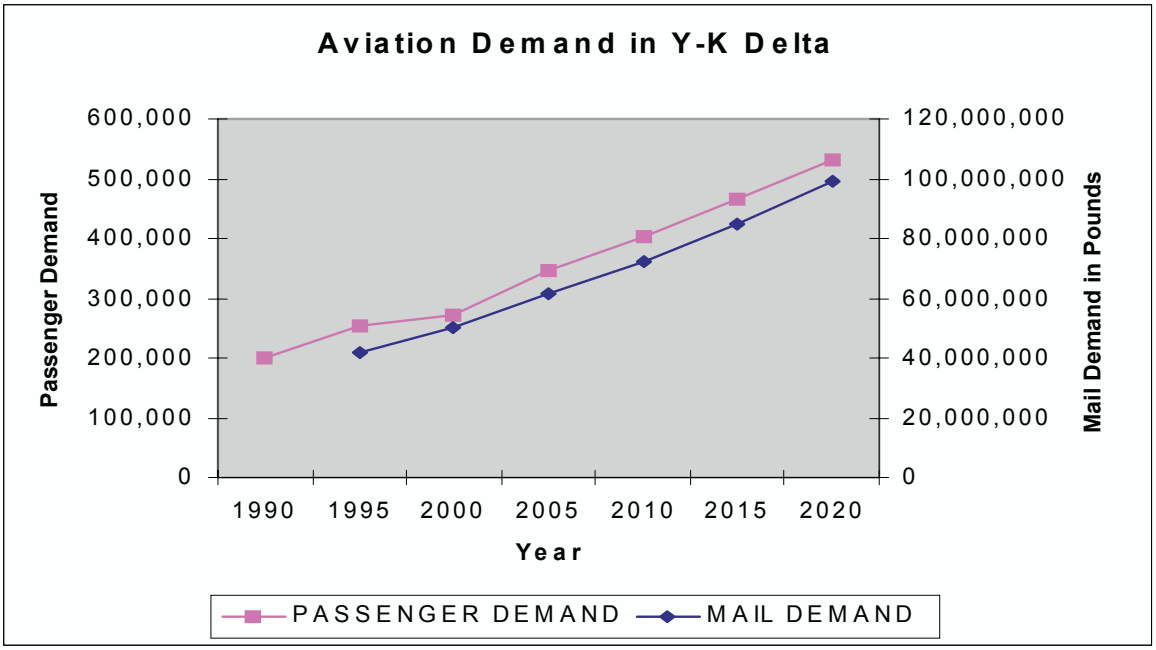

Figure 21 Aviation Passenger and Freight Forecast

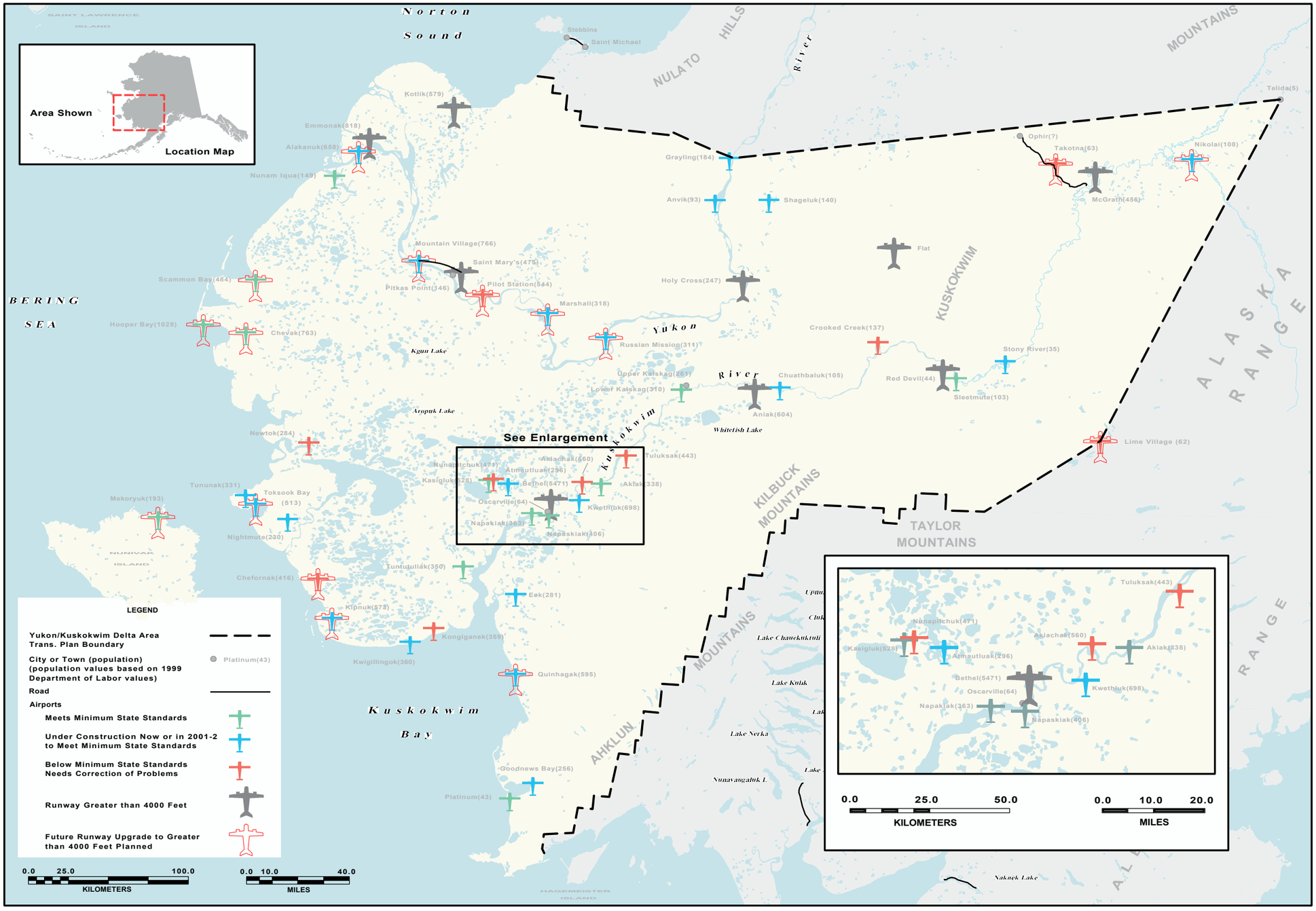

Figure 22 Airports and Recommendations (AK DOT&PF)

Village	1999 Pop. Est.	Appx Air Mlles to Hub	Present Runway Dimen.	Minimum Runway Dimen. Needed	Date Needed	Reason for Need	Project Status
BETHEL — (Hub)							
Bethel (Major Hub) (Incl Oscarville)	5,535	NA	6,398 x 150 Precision App.	OK	Continued Improvement	Regional Hub Airport	Master Plan Being Implemented
VILLAGES NEAR BETHEL — HUB (Bethel)							
Akiachak	560	14	1625 x 50	3300 x 60	ASAP	9 Passengers	Local Sponsor
Akiak	338	20	3200 x 60	3300 x 60	—	9 Passengers	Complete
Atmautluak	296	19	2000 x 40	3300 x 60	ASAP	9 Passengers	In Construction
Kasigluk	528	24	3200 x 60	3300 x 60	—	9 Passengers	Complete
Kwethluk	698	14	1700 x 40	3300 x 60	ASAP	9 Passengers	In Construction
Napakiak	363	12	3200 x 60	3300 x 60	—	9 Passengers	Complete
Napaskiak	406	6	3000 x 60	3300 x 60	—	9 Passengers	Complete
Nunapitchuk	471	23	2040 x 60	3300 x 60	ASAP	9 Passengers	Terrain Limits to 2500ft.
Oscarville	64	6	No Airport	Service from Napaskiak and Bethel			
Tuluksak	443	37	2500 x 30	3300 x 60	ASAP	9 Passengers	In Master Plan
ANIAK PLUS NEARBY VILLAGES ON KUSKOKWIM — HUB (Aniak)							
Aniak	604	0	6000 x 150	6000 x150	N/A	USPS Hub	Complete
Chuathbaluk	105	11	1560 x 60	3300 x 60	ASAP	9 Passengers	Construction 2003
Crooked Creek	137	47	2000 x 60	3300 x 60	ASAP	9 Passengers	Terrain Limits / Master Plan
Kalskag	571	26	3300 x 60	3300 x 60	—	9 Passengers	Complete
Red Devil	44	76	4750 x 74	4500 x 100	—	Fire / Resource	Complete
Sleetmute	103	82	3100 x 60	3300 x 60	—	9 Passengers	Complete
Stony River	35	100	2555 x 60	3300 x 60	ASAP	9 Passengers	Construction 2003
McGRATH PLUS NEARBY VILLAGES — HUB (McGrath)							
McGrath	423	0	5200 x 150	5200X150	—	USPS Hub	Complete
Takotna	48	14	1717 x 65	4000 x 75	ASAP	Fly Fuel	Relocate / Master Plan
Nikolai	105	46	2350 x 60	4000 x 75	—	Fly Fuel	Complete
Flat	12	77	4045 x 114	4000x 75	—	Fly Fuel	Complete
Lime Village	62	110	1475 x 60	4000 x 75	ASAP	Fly Fuel	In Master Plan
LOWER-MID YUKON SERVED BY ANIAK — HUB (Aniak)							
Anvik	93	77	2910 x 75	4000* x 60	ASAP	9 Passengers	Construction 2004
Grayling	184	95	2315 x 60	4000* x 60	ASAP	9 Passengers	Construction 2005
Holy Cross	247	40	4000 x 100	4000 x 100	—	19 Passengers	Complete
Russian Mission	311	60	2700 x 50	3600* X 75	—	9 Passengers	Complete
			3600 x 75	4000 x 100	2010	19 Passengers	Terrain Limit Investigation
Shageluk	140	76	2300 x 50	3600* x 60	ASAP	9 Passengers	In Construction to 3600 feet
LOWER-YUKON SERVED BY ST. MARY'S — HUB (St. Mary's or Bethel)							
Saint Mary's incl Pitkas Point	621	0 or 98	6003 x 150	6000 x 150	—	USPS Hub	Complete
Marshall	318	27 or 75	1940 x 30	4000* x 100	—	19 Passengers	Complete
Mountain Village	766	18 or 110	2500 x 60	3300 x 60	ASAP	9 Passengers	Construction 2004
			3300 x 60	3500 x 75	2005	19 Passengers	Terrain Limited
Pilot Station	544	12 or 87	2520 x 55	4000* x 75	2005	19 Passengers	Construction beyond 2005
UPPER COASTAL — HUB (Emmonak)							
Emmonak	818	0	4400 x 75	4400 x 100	—	USPS Hub	Complete
Alakanuk	658	8	2200 x 55	4000* x 75	ASAP	19 Passengers	In Construction
Nunam Iqua	149	21	3000 x 60	3300* x 60	—	9 Passenger	Complete
			3300 x 60	4000 x 75	2018	19 Passengers	New Master Plan Needed
Kotlik	579	34	4400 x 100	4000* x75	—	19 Passengers	Complete
MIDDLE COASTAL — HUB (Bethel)							
Hooper Bay	1028	151	3300 x 75	4400 x 100	2004	Future Hub	In Master Plan
Chevak	763	135	2600 x 40	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
Scammon Bay	484	144	3000 x 75	3300 x 60	—	9 Passengers	Complete
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
LOWER-MIDDLE COASTAL — HUB (Bethel)							
Chefornak**	416	90	2500 x 35	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4000 x 75	2015	19 Passengers	New Master Plan Needed
Kipnuk**	573	96	2120 x 35	3300 x 60	ASAP	9 passengers	In Construction*
			3300 x 60	4000 x 75	2015	19 Passengers	Present Terrain Limit to 3300
Mekoryuk	193	150	3070 x 75	3300 x 100	—	9 Passengers	Complete
Newtok	284	95	2010 x 40	3300 x 60	ASAP	9 Passengers	On Hold
Nightmute	230	101	1600 x 40	3300 x 60	ASAP	9 Passengers	Construction 2003
Toksook Bay	513	112	1800 x 55	3300 x 60	ASAP	9 Passengers	In Construction
			3300 x 60	4400 x 100	2015	USPS/Cargo Hub?	New Master Plan Needed
Tununak	331	117	2010 x 40	3300 x 60	ASAP	A/P Capability	Construction 2004
KUSKOKWIM BAY & SOUTH COASTAL — Hub (Bethel)							
Eek**	281	40	1400 x 35	3300 x 60	ASAP	9 Passengers	In Construction
Kongiganak	359	76	1880 x 35	3300 x 60	ASAP	9 Passengers	Local Sponsor
Kwigillingok	360	78	2500 x 35	3300 x 60	ASAP	9 Passengers	Local Sponsor
Quinhagak	595	72	2600 x 60	3300 x 60	ASAP	9 Passengers	In Construction/Local Sponsor
			3300 x 60	4500 x 100	2010	Fish Haul	Local Sponsor
Tuntutuliak**	350	40	1800 x 28	3300 x 60	ASAP	9 Passengers	In Construction
Platinum	256	116	3640 x 60	3300 x60	—	Mining Transport	Complete
Goodnews Bay**	43	130	2850 x 80	3300 x 80	ASAP	9 Passengers	On Hold

Notes:
Although the State Standards are now 3300 feet runway length, all runways in excess of 3000 feet are shown as complete.
ALP is Airport Layout Plan
* Runways for villages served primarily by 9 passenger Navajo aircraft require longer than state standard.(minimum 3600, 4000 for safety)
** Airports being constructed in two stages. Stage one is soil preparation. Drainage usually takes 2-4 years before construction can be completed.

Table 1 Y-K Delta Airport Status Chart

2. Winter Trails

People throughout Alaska are increasing their use of faster and more reliable snow machines for winter travel. Village leaders and others speaking at public meetings during the planning process consistently asked DOT&PF to help improve winter trail safety. In the Y-K Delta, residents are traveling up to 300 miles for hunting, fishing, shopping, and to visit family and friends. From freeze-up in October until break-up in April/May, snow machine trails serve as the region's winter roads. The increase in overland travel and the distances traveled make trail marking essential.

A major element of the plan is a commitment to develop a winter trail marking system that improves safety. Figure 24 illustrates the approximately 900-mile network of major winter trails in the region. This map is the result of DOT&PF area planners and design teams working with villages to identify trails. Village leaders have also worked with staff to develop a standard marker (Figure 23) for trails. It is generally the case that village crews assemble and install the markers.

Reflectors, direction arrows, and other features, including special marking at rivers and lakes, and beacons at some of the open-country villages, are important elements of the trail marker system. The distance between markers will generally range from 200 to 500 feet depending on the terrain. In some coastal trail areas, trails will be moved inland to increase trail safety. In case of accidents or equipment breakdowns, travelers will be able to use a tripod marker and a cover carried on the snow machine to create a temporary shelter. The design for the markers is based on traditional driftwood markers from Bering Sea coastal villages. Because travelers are routinely using hand held Global Positioning System (GPS) navigation tools on the winter trails, the department is working to tie the trail markers to GPS coordinates.

The network is expected to be complete in five to eight years. The estimated cost for installing permanent trail marking ranges from $1,500 to $2,000 per mile. It will require $1.3 to $1.8 million of the department's ongoing Trail Marking capital program to complete the Y-K Delta winter trails marking project.

While the planning process was able to identify trails that qualify for permanent markers, a number of complications require that priority order of marking and final costs, be developed by DOT&PF design teams currently working on the trail marking program.

Complications include crossing National Wildlife Refuge lands and Native allotments, final route selections, agreements with villages for construction and maintenance, and other fiscal and land use issues. DOT&PF design teams are working aggressively to meet this known priority along those routes that can be quickly approved while continuing to work with land managers, villages, and others to approve and develop the more complex trails.

Figure 23 Trail Marker Tripod (DOT&PF); Hand-Held GPS Receiver (Garmin e-Trax website)

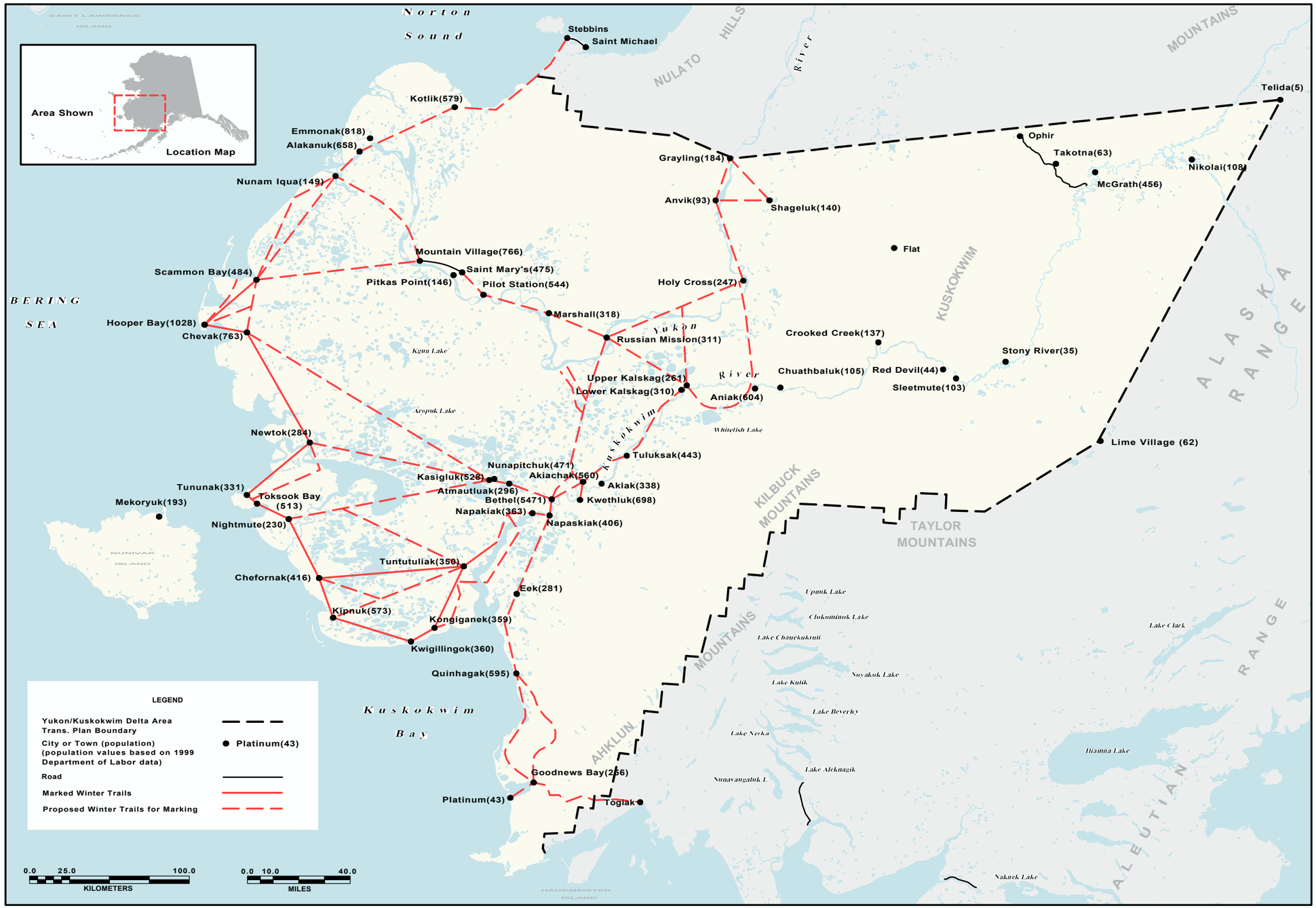

Figure 24 Winter Trails

3. Roads

An important planning task was looking at the concept of connecting some Y-K Delta villages that are close to one another by roads. The goal was to see if roads would reduce state M&O costs by consolidating public facilities including airports, health clinics, and schools in hub villages.

Coastal and Tundra Village Roads

The team found that constructing new roads in the Y-K Delta's coastal and tundra sections is not cost effective. Despite the short distances between some villages, the area's prevailing wetland/permafrost soils, frequent need for structures, high mobilization costs for contractors, and absence of gravel sources combine to create construction costs that range from $2.5 to $4.0 million per mile using a recent design report for the Napakiak to Bethel cost estimates as a base model. Given the small populations in the villages and the alternate transportation modes available, these construction costs do not compare well to the service provided.

M&O costs are also high compared to other regions of the state because of the area's relatively warm permafrost, pervasive drainage problems, and the high cost of importing gravel to maintain roadway surfaces.

The planning team did find that repairing the existing St. Mary's to Mountain Village Road on the lower Yukon River, a project currently under consideration, is a cost effective project. A similar road between Upper and Lower Kalskag on the Kuskokwim River is currently serviceable, but requires substantial maintenance effort.

The coastal village of Toksook Bay requested roads to Tununak and Nightmute on Nelson Island. Akiachak and Napakiak requested roads to Bethel. None of these roads appear to lower the cost of living for villages but would increase M&O costs for the department. Other road requests received during the planning process included a Russian Mission road to State and Village Corporation mineral lands. Table 2 details four of the road requests.

Equally important, most villages in this area expressed reservations about new roads to connect villages. Concerns included:

- A reluctance to forego village clinics, schools, or local airports in favor of consolidated facilities at a hub village
- Wider access to local subsistence resources
- The cost to develop car and truck fleets for transporting people and goods between villages

Due to road construction costs and community preferences, aircraft, snow machines, boats, and barges will continue to be the primary inter-village modes of transport in the coastal and tundra portions of the Y-K Delta.

Table 2 New Roads Requested in the Coastal Area of Y-K Delta

City Pair	Distance	Planning Estimate	Advantages	Disadvantages
Bethel to Napakiak (Reconnaissance study done)	12 mi.	$24M	Provides more convenient access to Bethel amenities.	Sufficiently far from Bethel that joint services are not likely. Significant wetland and river construction constraints.
Nunivak Island from North to South	50 mi.	N/A	Access to major fishing grounds on south side of island. Terrain is good for road construction.	Crosses through the middle of National Wildlife Refuge, including substantial portions of wilderness area.
Tununak to Toksook Bay	8 mi.	$12 M based on Napakiak and other road studies	Reasonable terrain, land owned by the two village corporations, connecting villages of 330 and 500. Possible consolidation of airport facilities, schools, health care, and other services now done separately.	Tununak wants to keep airstrip. No vehicles to use road.
Akiachak to Bethel	14 mi.	$25+M based on Napakiak study	Strongly urged by the local village council. Provides access that is more convenient to Bethel.	Sufficiently far that joint service is not likely. Significant wetland and river construction constraints.

Inland Resource Roads

In contrast to the coastal and tundra areas, the inland, rolling hills portion of the planning area does have suitable terrain and soils for standard road construction. The planning team found that a long-term project to build a road that accesses area minerals and completes the Ruby-to-McGrath link in the western end of the world-class Tintina Gold Belt district (Figure 26) could significantly contribute to the entire region's economic development.

Figure 25 Road Grading (DOT&PF)

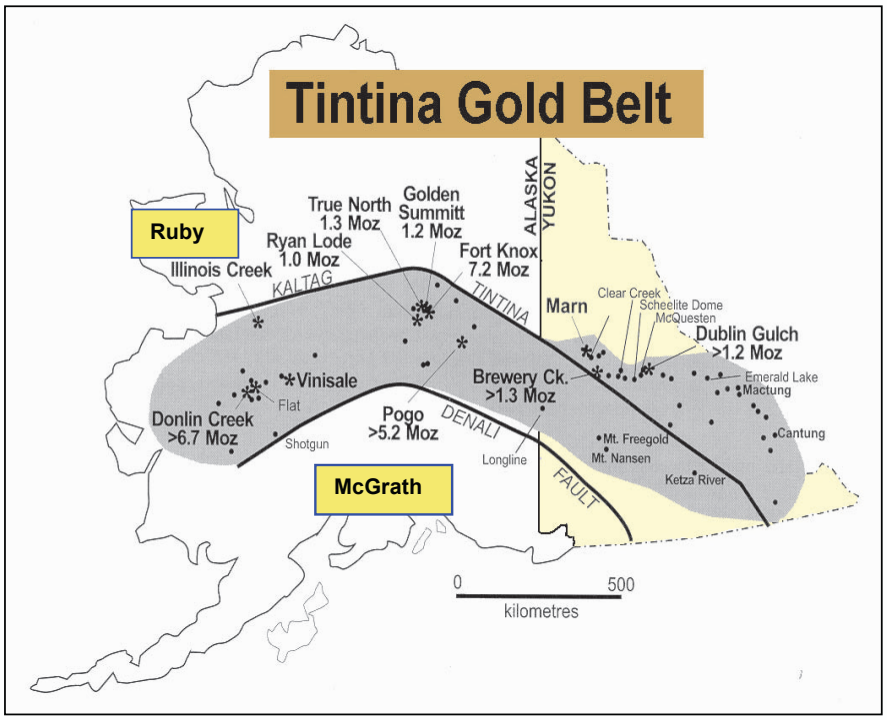

Figure 26 Mineral Resource Rich Deposits (Moz = Million ounces)

The U.S. Army Corps of Engineers (USACE) noted in their 1997 study of the Kuskokwim River that the upper reaches of the river beyond Crooked Creek are fraught with navigation problems and limitations. Their report states:

> …companies presently using the river to transport waterborne commerce are experiencing high operating costs due to the inability to operate at full capacity, delays caused by shallow water crossings and inability to access off- loading areas near enough to destination villages… it is apparent that deepening the shallow-water crossing would produce significant economic benefits: however those benefits would not likely exceed the costs.[2]

Segments of the Ruby-to-McGrath Road, south from Ruby on the Yukon River and north from Sterling Landing on the Kuskokwim River, were constructed in the 1930s, but work was halted during World War II. The project has been examined as recently as 1993 in the Ruby-to-McGrath Road Feasibility Study[3] prepared for the City of Ruby. That study estimated construction costs at $220-240 million for a direct route between Ruby and McGrath. The proposal outlined in this plan includes access to mineral deposits at Reef Ridge and Donlin Creek. These elements add costs to the estimate prepared by Manley Land Surveyors. Those costs and a review of the direct link costs are being evaluated

2. U.S. Army Corps of Engineers, *Expedited Reconnaissance Report and GIS Database - Kuskokwim River*, Alaska District, September 1997.
3. Manley Land Surveyors, Inc. *Ruby-to-McGrath Road Feasibility Study*, 1993.

in the department's Northwest Alaska Transportation Plan currently underway.

Informal discussions with communities along the route reveal strong community support for completing the road. Mine owners in the district indicate opportunities for public/private construction-stage partnerships and road maintenance agreements, two compelling ingredients in today's highway construction financing environment.

Project elements, listed in likely order of development include:

- Rehabilitate 54-mile federal-aid route from Ruby on the Yukon River south to Poorman
- Construct a 40- to 50-mile road to the Reef Ridge zinc mine southeast of Poorman
- Construct a 75- to 90-mile road between Poorman and Ophir
- Construct a 60-mile segment from Ophir to the Donlin Creek mining district
- Rehabilitate 38-mile federal-aid route from Sterling Landing on the Kuskokwim River north to Ophir
- Construct a 12- to 18-mile segment to McGrath

Figure 27 Core Drilling for Gold, Fred Creek (Alaska Mineral Industry Report 1999)

Figure 28 Pogo Mine Entrance (Alaska Mineral Industry Report 1999)

This road would initially provide mining operations with an intermodal connection to the Yukon River, the only navigable water capable of transporting products in to develop the region, and transporting ore concentrates and other products out of the region. The road, in its final stage, would also provide an intermodal connection to McGrath's 5,400-foot hub airport that would serve the area's community, commercial, and industrial aviation transport needs. The road would tend to focus transport of fuel and commercial products out of Fairbanks, helping to diversify and expand the Fairbanks-area economy.

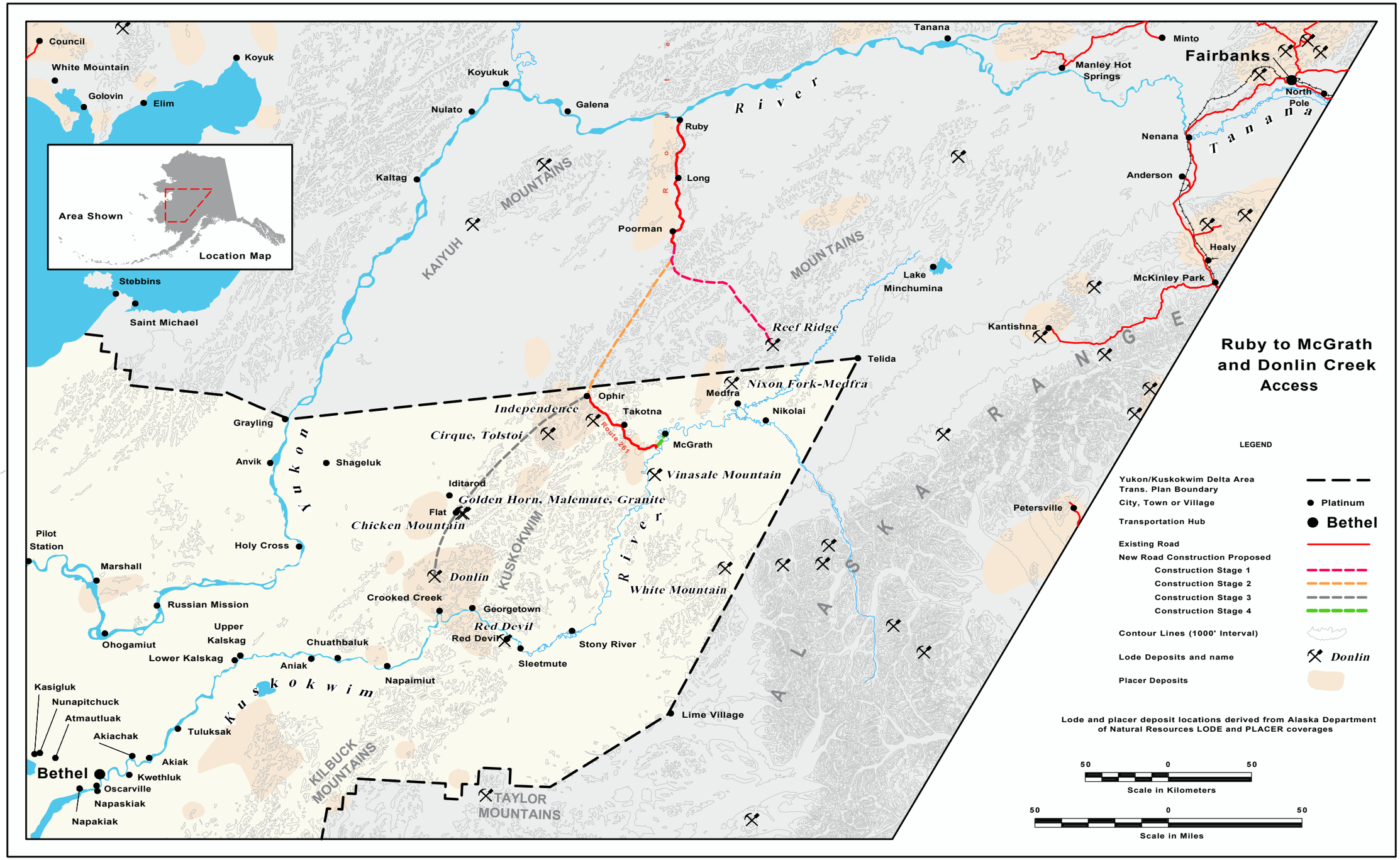

Figure 29 Ruby / McGrath Road

Figure 30 McGrath Airport – One Intermodal Connection Point (DOT&PF)

The Ruby-to-McGrath Road is an important element in the region's shift from a salmon-fishing-based economy to a more diverse economy that focuses on halibut/crab fisheries along the coast and mining developments in the region's upper reaches. The road may also support a long-term proposal for a coal-fired power generation plant and electric distribution lines to villages and mine sites in the district. Road construction and the mine developments that follow present a strong opportunity for workforce development in the region.

DOT&PF has transferred this proposal to the adjacent Northwest Alaska Transportation Plan that will define routes, quantify construction and maintenance costs, investigate partnership opportunities, and illustrate economic and social benefits the road would provide. The evaluation will include a new round of meetings in communities along both the Yukon and Kuskokwim Rivers to confirm that the public continues to support the project.

Figure 31 Village of Ruby and the Road to Poorman (FAA, Alaska Region)

4. Bering Sea Port

Bethel is the Y-K Delta's only deep-water port. Line-haul barges that follow the Bering Sea ice edge north along the coast each summer serve the Bering Sea coast villages. These barges have to stand several miles offshore and unload onto shallow draft lightering barges for delivery to shore. Some barge operators and the community of Mekoryuk on Nunivak Island proposed that a subregional port would improve line-haul barge operations and would allow shallow draft barges to serve coastal villages more efficiently.

In addition, the new nearshore crab and halibut fisheries, managed and promoted by multi-village Community Development Quota (CDQ) fishing organizations, would benefit from an improved harbor and fish

transfer dock that could be developed in conjunction with a subregional port.

DOT&PF, Coastal Villages Region Fund (the local CDQ organization), and USACE agreed to fund a subregional port study. The USACE study examined port development sites along the Bering Sea coast, including Nunivak Island, and investigated a new port's economic potential.

USACE found that there is insufficient fuel and freight movement along the coast to warrant construction of a federally-funded port facility. Further analysis of harbor and fish transfer facilities is being considered. The conclusions of the study reinforce the difficulties of major navigation and port development projects in this region of small populations and challenging construction.

5. Barge Moorings and Landings

The region's rivers provide barges with access to deliver fuel, heavy goods, and construction materials to most villages. Each village depends on summer delivery of a year's fuel for its heating, electric power, and transportation needs. To load and unload, barges must be held against transfer sites by river tugs. This results in river bottom and bank erosion and a potential for oil spills. In addition, village barge landings themselves are generally unimproved contributing to freight handling difficulties that increase costs. Building a mooring system, or barge face and gravel pad, at each landing would improve barge operations and provide a site for fuel transfer headers. This plan identifies short- and long-term approaches to address the lack of barge moorings. DOT&PF is working with the Denali Commission and others to identify funding for these projects.

The projects may meet the Commission's mandate for local-level capital projects that enhance quality of life in rural Alaska. DOT&PF staff are working with the barge operators and the villages to define projects for consideration by funding agencies.

Figure 32 Barge Unloading in Quinhagak (DOT&PF)

Conclusion

The Y-K Delta region presents significant transportation challenges to DOT&PF. The large coastal villages have many needs. The lack of roads and cost-effective road building opportunities puts pressure on the region's other modes of transportation. With its growing population and increasing use of consumer products as well as traditional resources, the people of the Y-K Delta are placing ever greater demands on the existing transportation infrastructure.

Practical ways that DOT&PF can improve the existing transport systems are upgrading airports to improve safety and meet future demand, and marking winter trails to improve traveler safety. This plan lays out a commitment to those improvements.

In the upper Kuskokwim River/Yukon River area, new road construction to the Reef Ridge and Donlin Creek mine site destinations and eventually to the upper Kuskokwim community of McGrath may generate significant economic and social benefits. This area, despite its mineral potential, is effectively closed to large-scale mining by a lack of transportation infrastructure. A road network that provides access for these mines to Yukon River barges and eventually the McGrath hub airport appears to be the key to a more diverse, stable economy in Western Alaska.

DOT&PF is committed to an analysis that illustrates construction and maintenance costs, investigates cost-sharing opportunities, determines timing and feasibility of constructing access, and outlines the economic and social benefits that would result from the project.

Building harbor facilities and a fish transfer dock at Mekoryuk and/or other Bering Sea villages is a project that needs further consideration as it appears likely these improvements would be important to the region's growing crab/halibut commercial fisheries.

Finally, the department is supporting efforts to develop barge moorings and landings for river villages by working with villages and the region's barge operators to identify projects that will enhance safety, improve product delivery, and expedite handling.

DOT&PF will continue to work with the Denali Commission and other funding agencies on the barge operation improvements.